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SPECIAL AREAS OF ADMINISTRATION

Canada, Royal Commission on Government
Organization,
Report,
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VOLUME

SPECIAL AREAS OF ADMINISTRATION

PUBLISHED BY THE QUEEN'S PRINTER • OTTAWA • CANADA FOR
THE ROYAL COMMISSION ON GOVERNMENT ORGANIZATION



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ROYAL COMMISSION ON GOVERNMENT ORGANIZATION

J. GRANT GLASSCO

F. EUGÈNE THERRIEN

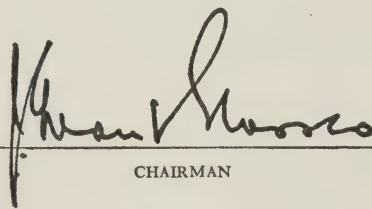
WATSON SELLAR

To His Excellency

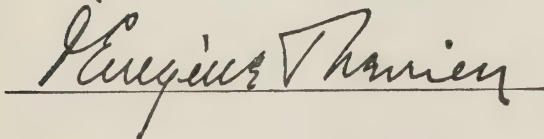
THE GOVERNOR GENERAL IN COUNCIL

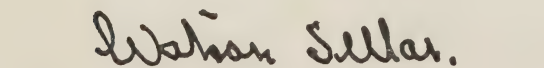
May It Please Your Excellency

We, the Commissioners appointed by Order in Council dated 16th September, 1960 to inquire into and report upon the organization and methods of the departments and agencies of the Government of Canada and to make recommendations concerning the matters more specifically set forth in the Order in Council dated 16th September, 1960: Beg to submit to Your Excellency the following Reports.



CHAIRMAN





January 21, 1963.



Elizabeth the Second

BY THE GRACE OF GOD ✻
OF THE UNITED KINGDOM,
CANADA ✻ AND HER OTHER
REALMS AND TERRITORIES

Queen

HEAD OF THE COMMONWEALTH
DEFENDER OF THE FAITH ✻

A handwritten signature in dark ink, appearing to read 'P. K. Meunier'.

DEPUTY GOVERNOR GENERAL

A handwritten signature in dark ink, appearing to read 'E. A. B. Macdonald'.

DEPUTY ATTORNEY GENERAL

TO ALL TO WHOM THESE PRESENTS SHALL COME
OR WHOM THE SAME MAY IN ANYWISE CONCERN,

Greeting:

WHEREAS pursuant to the provisions of Part I of the Inquiries Act, chapter 154 of the Revised Statutes of Canada, 1952, His Excellency the Governor in Council, by Order P.C. 1960-1269 of the sixteenth day of September, in the year of Our Lord one thousand nine hundred and sixty, a copy of which is hereto annexed, has authorized the appointment of our Commissioners therein and hereinafter named to inquire into and report upon the organization and methods of operation of the departments and agencies of the Government of Canada and to recommend the changes therein which they consider would best promote efficiency, economy and improved service in the despatch of public business, and in particular but without restricting the generality of the foregoing, to report upon steps that may be taken for the purpose of

- eliminating duplication and overlapping of services;
- eliminating unnecessary or uneconomic operations;
- achieving efficiency or economy through further decentralization of operations and administration;
- achieving improved management of departments and agencies, or portions thereof, with consideration to organization, methods of work, defined authorities and responsibilities, and provision for training;
- making more effective use of budgeting, accounting and other financial measures as means of achieving more efficient and economical management of departments and agencies;
- improving efficiency and economy by alterations in the relations between government departments and agencies, on the one hand, and the Treasury Board and other central control or service agencies of the government on the other; and
- achieving efficiency or economy through reallocation or regrouping of units of the public service.

and has conferred certain rights, powers and privileges upon Our said Commissioners as will by reference to the said Order more fully appear.

NOW KNOW YE that, by and with the advice of Our Privy Council for Canada, We do by these Presents nominate, constitute and appoint J. Grant Glassco, Esquire, of the City of Toronto, in the Province of Ontario; Robert Watson Sellar, Esquire, of the City of Ottawa, in the Province of Ontario; and F. Eugene Therrien, Esquire, of the City of Montreal, in the Province of Quebec, to be Our Commissioners to conduct such inquiry.

TO HAVE, hold, exercise and enjoy the said office, place and trust unto the said J. Grant Glassco, Robert Watson Sellar and F. Eugene Therrien, together with the

rights, powers, privileges and emoluments unto the said office, place and trust of right and by law appertaining during Our Pleasure.

AND WE DO hereby direct that the scope of the inquiry shall not extend to the institution of Parliament.

AND WE DO hereby authorize Our said Commissioners to exercise all the powers conferred upon them by section 11 of the Inquiries Act and be assisted to the fullest extent by government departments and agencies.

AND WE DO hereby authorize Our said Commissioners to adopt such procedure and methods as they may from time to time deem expedient for the proper conduct of the inquiry and sit at such times and at such places in Canada as they may decide from time to time.

AND WE DO hereby authorize Our said Commissioners to engage the services of such counsel, staff and technical advisers as they may require at rates of remuneration and reimbursement to be approved by the Treasury Board.

AND WE DO hereby require and direct Our said Commissioners to report their findings to Our Governor in Council, making interim reports as progress is made, with the final report to be made within a period of two years.

AND WE DO hereby require and direct Our said Commissioners to file with the Dominion Archivist the papers and records of the Commission as soon as reasonably may be after the conclusion of the inquiry.

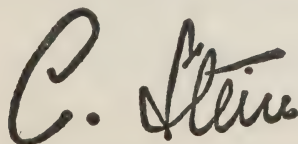
AND WE FURTHER appoint J. Grant Glassco, Esquire, to be Chairman of Our said Commissioners.

IN TESTIMONY WHEREOF We have caused these Our Letters to be made Patent and the Great Seal of Canada to be hereunto affixed.

WITNESS: The Honourable Patrick Kerwin, Chief Justice of Canada and Deputy of Our Trusty and Well-beloved Major-General George Philias Vanier, Companion of Our Distinguished Service Order upon whom We have conferred Our Military Cross and Our Canadian Forces' Decoration, Governor General and Commander-in-Chief of Canada.

AT OTTAWA, this Twenty-seventh day of September in the year of Our Lord one thousand nine hundred and sixty and in the ninth year of Our Reign.

By Command,

A handwritten signature in dark ink, appearing to read "C. Steine". The signature is fluid and cursive, with a large initial "C" and a stylized "Steine".

UNDER SECRETARY OF STATE

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19 CANADIAN BROADCASTING CORPORATION

SPECIAL AREAS OF ADMINISTRATION

REPORT 19: CANADIAN
BROADCASTING
CORPORATION

PUBLISHED BY THE QUEEN'S PRINTER • OTTAWA • CANADA FOR
THE ROYAL COMMISSION ON GOVERNMENT ORGANIZATION

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ACKNOWLEDGEMENTS

The detailed investigation of the Canadian Broadcasting Corporation was undertaken by a Project Group under the direction of G. H. Cowperthwaite, F.C.A., *Peat, Marwick, Mitchell & Co.*, Toronto.

A number of Project Officers were associated with this endeavour, and your Commissioners, in recording their names below, wish to acknowledge the assistance received:

R. C. Berry, C.A., *Peat, Marwick, Mitchell & Co.*, Toronto

W. K. Best, C.A., *Peat, Marwick, Mitchell & Co.*, Toronto

George Forrester, M.SC., M.COM., *Peat, Marwick, Mitchell & Co.*, Toronto

Fernand Malo, M.A., *Dominion Tar and Chemical Company Limited*, Montreal

Charles F. Stubbart, B.COM., *Ford Motor Company of Canada Limited*, Oakville, Ontario.

In addition, H. O. R. Hindley, M.A., Research Co-ordinator on the Central Staff, was assigned to the project.

Your Commissioners, in acknowledging the assistance and advice received, dissociate all those named above from any of the findings and conclusions contained in this report; for these, your Commissioners assume full responsibility.

1

INTRODUCTION

In Volume 5, your Commissioners deal at some length with the distinctions between departmental and non-departmental forms of organization within the public service, and suggest criteria which may make the departmental form appropriate for certain kinds of activity, the non-departmental form more appropriate for others. As a part of the investigations upon which their conclusions on this broad subject were based, your Commissioners studied in varying degrees of detail a number of agencies and Crown corporations. Certain aspects of the study made of the Canadian Broadcasting Corporation for this purpose seem to merit a special report.

The Corporation has been studied and appraised over recent years by a series of Parliamentary Committees and a Royal Commission. These inquiries have usually included the crucial question of the role of a Crown corporation responsible for providing "a national broadcasting service" as well as the effectiveness with which the CBC was discharging its role. Your Commissioners have been only incidentally concerned with the first of these questions, which is one of important national policy. The Commission's terms of reference direct attention chiefly to the suitability of the present form and organization of the CBC to its role, and to the quality of management it brings to its task. In assessing these major questions of organization and operation, your Commissioners necessarily touch on important questions of public policy, not to provide answers to them but to show their influence on the policies, organization, and performance of the Corporation.

During the early stages of your Commissioners' studies the Special Com-

mittee on Broadcasting, 1961, was holding hearings. Its report to the House of Commons, dated June 28, 1961, contains the following recommendation:

That following a review of the Glassco Royal Commission's report consideration be given by the Board of Directors of the Canadian Broadcasting Corporation to the advisability of commissioning management consultants to inquire further into the operation of the Canadian Broadcasting Corporation.

Your Commissioners did not undertake the detailed investigation and appraisal which the above recommendation may have envisioned, but this report does propose guidelines and criteria which, subject to government decisions on policy, should permit the CBC to adjust its internal organization and operations to management and performance needs, with the aid of such advice, from within the government or elsewhere, as it may consider necessary.

This report is, then, concerned with three principal subjects:

- The relationships between the Corporation, the Cabinet and Parliament, including the adequacy of the policy guidance and definition of task which the Corporation is given, as well as the clarity of the standards of performance upon which it is to be judged.
- The kind of Board of Directors which its role and relationship to the Governor in Council suggest the CBC should have, as well as the appropriate relationships between the Board of Directors and the responsible Minister on one hand and the Board of Directors and the responsible management of the Corporation on the other.
- The suitability of the Corporation's management and its organization for its present tasks, in light, particularly, of the fact that the very rapid growth following the development of television has subjected the Corporation and its senior management to immense new pressures and challenges to which it has had to respond quickly.

This report does not explore the current difficulties of the Corporation in meeting a second major adjustment—that arising from the emergence of large-scale competition from private television broadcasters. Beyond this are other decisions having major financial implications, involving, for example, the use of colour television; and technological advances are proceeding so rapidly that it would be unrealistic to assume that conditions will remain static. In such circumstances your Commissioners believe that the need is to state in unequivocal terms the nature and scope of the Corporation's responsibilities and to create the financial environment in which responsible management may properly plan and administer its affairs.

2

THE SETTING

The Corporation was created in 1936 as the successor to the Canadian Radio Broadcasting Commission and it is now operating on a scale that involves the expenditure of around \$100 million a year. From 1936 to 1952, when television services were inaugurated, the staff increased from 133 to 1,565 and has multiplied more than five times since then. On September 30, 1961, when this survey was undertaken, the Corporation was employing 7,993 persons, of whom 824 were in headquarters (including 283 in the engineering headquarters in Montreal), 149 in the international service in Montreal, 2,552 in the French network and Quebec region headquarters, 2,306 in the English network and Toronto area headquarters, and 2,162 distributed among other regions and areas from coast to coast.

RELATIONS WITH PARLIAMENT AND MINISTERS

The legislative provisions which currently regulate the relationships and activities of the Corporation are set out in *The Broadcasting Act* enacted in 1958, following a comprehensive inquiry into broadcasting in Canada by a Royal Commission (the Fowler Commission). Part I establishes a Board of Broadcast Governors with broad regulatory powers, and Part II treats with organization and activities of the Canadian Broadcasting Corporation. The task of the Corporation is stated this way:

29. (1) The Corporation is established for the purpose of operating a national broadcasting service, and in particular, but without restricting the generality of the foregoing, has power to
- (a) maintain and operate broadcasting stations and networks of broadcasting stations;

- (b) establish, subject to approval of the Governor in Council, such broadcasting stations as the Corporation considers necessary or desirable;
 - (c) equip broadcasting stations with all such plant, machinery and other effects as it considers necessary or desirable;
 - (d) make operating agreements with broadcasting stations for the broadcasting of network programs;
 - (e) originate programs and secure programs, from within or outside Canada, by purchase or exchange and make arrangements necessary for their transmission;
 - (f) make contracts with any person, in or outside Canada, in connection with the production or presentation of the programs of the Corporation;
 - (g) make contracts with any person, in or outside Canada, to perform in connection with the programs of the Corporation;
 - (h) publish and distribute, whether gratis or otherwise, such papers, periodicals and other literary matter as may seem conducive to any of the objects of the Corporation;
 - (i) collect news relating to current events in any part of the world and in any manner that it deems fit and to establish and subscribe to news agencies;
 - (j) acquire copyrights and trade marks;
 - (k) acquire and use any patent, or patent rights, *brevets d'invention*, licences or concessions that the Corporation may consider useful for the purpose of carrying out its objects;
 - (l) make arrangements or agreements with any organization for the use of any rights, privileges or concessions that the Corporation may consider useful for the purpose of carrying out its objects;
 - (m) acquire broadcasting stations either by lease or, subject to the approval of the Governor in Council, by purchase; and
 - (n) do all such other things as the Corporation may deem incidental or conducive to the attainment of any of the objects or the exercise of any of the powers of the Corporation.
- (2) The Corporation is bound by the provisions of Part I.

The Corporation has a board of directors, comprising the President, Vice-President and nine other directors. The duties of the officers and board severally are not specified nor is statutory provision made for a presiding officer of the board. One of the nine directors has, however, been named (by the government) as Chairman of the Board. Responsibility is thus borne collectively by the members of the Board. The President and Vice-President are engaged full time on the Corporation's business; the Chairman of the Board—also Chairman of the Finance Committee—spends about half his time on Corporation affairs; the remaining directors attend board meetings.

The Corporation is required to report to Parliament through a minister designated by the Governor in Council, at present the Secretary of State. The statute does not make the Minister accountable for the policies of the Corporation nor is he required to give any directions with respect to programming or day-by-day activities of the Corporation. Questions asked in Parliament are referred to the Corporation and the answers prepared by it are presented by the Minister.

Both the operating and capital budgets of the Corporation must receive the approval of the responsible minister and the Minister of Finance and be annually laid before Parliament. In addition, once each five years a capital

programme and financial forecast for the ensuing five years must be submitted to the Governor in Council. Property transactions involving more than \$100,000 require the approval of the Governor in Council. In practice, the budgets of the Corporation and all contracts in excess of \$100,000 are reviewed by the Treasury Board. The Auditor General of Canada is the auditor of the Corporation and reports annually thereon to Parliament.

In both 1959 and 1961 special committees of the House of Commons were formed to inquire into broadcasting in general and the Canadian Broadcasting Corporation in particular. The 1961 Committee held forty-two meetings over a period of several months and the transcript of evidence ran to approximately one thousand pages. Reviews by committees of Parliament necessarily place additional burdens on the administrative officers of the Corporation; but they may have a special value, in that they provide opportunity for policy guidance as well as assessment of performance.

DEFINITION OF THE TASK

Virtually the entire terms of reference to the Corporation have since its formation consisted of a simple direction: to carry on a "national broadcasting service". In the absence of any statutory or authoritative definition of that phrase, the Corporation has over the years made its own interpretations and then proceeded to create the sort of service which it considered appropriate.

In many fields compliance with a general direction of this nature would not be difficult. A direction, for example, to operate a ferry service would implicitly create boundaries for the activity in the form of the nature and volume of traffic and generally accepted practices in meeting the physical aspects of the task. But there are no such boundaries in a new and growing field such as broadcasting—a national broadcasting service can take a hundred forms, ranging in cost from a few million dollars to more than the hundred million now being spent.

The most fundamental policy change since the Corporation was established in 1936 was the decision to inaugurate television broadcasting. This was a formal government decision in 1949 and appears to be the only instance of guidance by government in defining the role of the Corporation.

Of the 77 television stations embraced by the English and French networks in 1961, only 13 were operated by the Corporation, the balance being privately owned. A limitation, such as contained in Section 29(1)(b) of *The Broadcasting Act*, with respect to establishing new stations is therefore of little effect in controlling the scope of activities. The questions which really determine the scale of expenditures are:

- The amount of broadcasting—how many hours per week?
- The size of the audiences to be served, through networks and the Corporation's own stations.
- The commercial policy—is advertising revenue to be sought, and if so, how aggressively?
- The quality of programming and the scope of the Corporation's own production activities.

When television was inaugurated in Toronto and Montreal in September 1952, broadcasting was at the rate of twenty hours per week. Nine years later it had risen to between eighty and ninety hours weekly. Table 1 shows the growth in broadcast time on eight of the principal stations. No criticism is implied with respect to this development—it is cited merely as an example of a policy decision taken within the Corporation, which involves very large sums of money. The amount of broadcast time has a direct bearing on communications costs for network transmission as well as an important influence on production requirements.

The Corporation's interpretation of its obligation to provide a "national broadcasting service" has led to the development of English and French language television networks which together reach ninety per cent of the population. The remainder reside in more remote areas, to service all of which would entail a prohibitive cost. Simultaneous presentation of television programmes is now possible through microwave facilities from St. John's, Newfoundland, to Victoria, British Columbia. Radio broadcasting reaches an even larger proportion of the people and the Corporation's broadcasts are available to all but three per cent of Canadian residents.

In the absence of direction the commercial policy of the Corporation has developed in a haphazard manner. Advertising revenues of over \$38 million annually were built up without any aggressive effort. The fact that private broadcasting is seriously threatening such revenue renders essential a firm decision on future policy.

Again, on the basis of the Corporation's own assessment of need, a production organization has been created which is one of the largest theatrical enterprises in the world. Policy has been to strive for superior quality and there is universal agreement that a very high standard has been reached. But no evidence exists of any weighing of cost against need and the impression gained is that, generally, the pursuit of high quality has been carried on without taking into consideration what the country can afford.

Table 1—CANADIAN BROADCASTING CORPORATION—TELEVISION BROADCASTING, HOURS PER WEEK

	<i>CBLT</i> <i>Toronto</i>	<i>CBFT</i> <i>Montreal</i>	<i>CBOT</i> <i>Ottawa</i>	<i>CBUT</i> <i>Vancouver</i>	<i>CBMT</i> <i>Montreal</i>	<i>CBWT</i> <i>Winnipeg</i>	<i>CBRT</i> <i>Halifax</i>	<i>CBOFT</i> <i>Ottawa</i>
September—1952	20.50	20.25						
March—1953	40.50	32.75						
October—1953	69.75	37.75	53.75					
March—1954	72.75	31.50	54.50	49.50	41.00			
October—1954	66.75	36.00	64.00	50.00	61.25	58.00		
March—1955	68.50	43.50	64.75	70.00	61.50	61.50	57.65	
October—1955	77.25	38.25	68.00	80.25	70.25	75.00	64.00	41.35
January—1956	75.00	54.50	66.25	68.50	67.00	73.25	63.50	53.00
January—1957	72.50	58.50	68.25	73.25	68.25	77.25	76.25	59.50
July—1957	56.25	46.75	57.00	61.50	60.75	66.00	58.50	46.50
January—1958	72.25	64.75	67.00	73.75	68.75	76.50	75.00	64.25
July—1958	61.00	46.25	59.25	65.75	63.00	68.75	62.50	46.50
January—1959	81.00	69.25	74.00	81.25	75.25	78.25	81.50	70.50
July—1959	61.75	48.00	63.75	64.75	72.25	70.25	68.75	46.75
January—1960	86.00	74.25	86.00	86.50	85.75	87.00	85.00	75.00
July—1960	58.50	51.50	64.00	64.00	70.25	68.50	66.25	51.00
January—1961	89.75	81.25	87.00	85.00	84.00	80.75	88.00	84.00

NOTE: (1) The above figures up to and including January 1956, were obtained from an analysis prepared by the Office of the Co-Ordinator of Television, dated February 16, 1956.
(2) Figures from July 1957 (representing Summer scheduling) and January 1958 (representing Winter scheduling) were obtained from current statistical data maintained by the Office of the Director of Operations Control.

In a rapidly developing field such as television, it is probably unrealistic to expect that policy should be enunciated in detail in the governing legislation, but an unfortunate omission is the lack of provision for general guidance by the government with respect to major policy decisions.

FINANCING THE CORPORATION

Each year Parliament is asked to vote the funds necessary to bridge the gap between corporate income and outgo. The scrutiny of these budgets is carried out by the staff of the Treasury Board, the outcome being usually an arbitrary reduction in the operating budget of three or four million dollars. No direction is given the Corporation concerning the control of either revenue or expenditure.

Parliament appropriated \$70,418,000 for the operating requirements of the Corporation in the fiscal year 1961-62. The Corporation had, in addition, advertising revenue (gross) of \$32,910,000 and other income of \$410,000. Operating expense totalled \$103,572,000 to which \$4,039,000 has to be added for depreciation, or an over-all total of \$107,611,000 operating cost. In addition, Parliament granted \$9,600,000 for capital requirements, but actual expenditure amounted to \$6,200,000. It is significant that advertising

revenue was 12.5 per cent below that of the previous year, and uncertainties as to the future of commercial revenues indicate the possible need for substantial future increases in amounts voted by Parliament if activities continue at the present scale. In these circumstances, forward planning becomes extremely difficult. The Fowler Commission recommended that certainty of financing for five years ahead should be provided to permit an orderly development of activities and your Commissioners agree that dependence on annual votes by Parliament seriously complicates the task of management. If, as appears quite possible, the Corporation is fated to lose much of its commercial revenue to private competition, management should know now whether or not it may count on increased appropriations of public funds so that it can plan accordingly.

3

THE BOARD OF DIRECTORS

The Corporation consists of the eleven individuals who form its Board of Directors. As already noted, they are the President and the Vice-President (individually appointed by Order in Council), and nine individuals, one of whom has been designated Chairman of the Board. It is on this group collectively that the responsibility rests for the operation of the Corporation. Attention is drawn earlier in this report to the need for a more precise definition of the responsibilities of the Corporation with regard to the provision of a national broadcasting service, and to the restrictive limitations imposed on the Board of Directors with regard to financial requirements. These handicaps are aggravated by certain other features of the present arrangements.

Of the eleven directors, only the President and the statutory Vice-President are required to devote their attention exclusively to the affairs of the Corporation. The Chairman (a non-statutory office) presides at meetings of the Board and is also Chairman of the Finance Committee. The President, as a statutory director, is prominent at Board meetings and is chairman of the statutory Executive Committee to which, by law, may be delegated all or any of the powers of the Corporation. Board meetings may extend over three or four days. No agenda are issued in advance, and at each meeting the part-time directors are confronted with a mass of financial and statistical data which neither they nor anyone else can digest and evaluate in the time available. The result is that, in fact, Corporation policy is largely dictated by management. This situation probably had its origin in the appointment of an entirely new Board in November, 1958, none of whom had any previous

experience of the affairs of the Corporation. The appointments were for a term of three years and, with one exception, all the part-time directors were re-appointed in 1961. Moreover, the statute stipulates that, after serving two consecutive terms, they are ineligible for re-appointment during the twelve months following the completion of the second term. Therefore an almost entirely new Board is in prospect within two years. The situation would be improved somewhat were a rotational system of appointment provided, and the Executive Committee composed of directors normally resident in or within easy reach of Ottawa.

Both the President and one Vice-President are appointed for a term of seven years. It is evident that, if smooth working relationships are to be achieved, these senior officers must be acceptable to the directors and to each other, and that their experience and qualifications should be mutually complementary. But at present there is no provision for consultation so as to ensure that these essential requirements are met. Responsibility for the effective management of an enterprise of this magnitude without the authority to select and, if necessary, dismiss the senior executives of the Corporation is a contradiction in terms.

Of the nine persons appointed to the Board in 1958, two were from the Maritimes, Quebec and Ontario, respectively, and one each from Manitoba, Alberta and British Columbia. The following is an analysis of their experience:

Active business executives—management level	3
Retired business executive	1
Writers, broadcasters	2
University professors	2
Labour and welfare	1

Two had previous broadcasting experience as announcers, commentators or free lances, the remainder none. The board is representative of the different regions of Canada and of certain segments of the population but, by residence, background and experience, it is better suited to the performance of advisory functions than to the heavy responsibility of administering this very large business.

Possible alternative arrangements to government by a board of directors would be to revert to a salaried Commission or to place the responsibility on a single officer, supported by an advisory committee of a representative nature. In fact, though not in form, the present arrangements accord closely to this pattern, since it is clear that the initiative lies with the President and the Board's authority is extremely circumscribed.

As in the case of other corporate agencies of the government, your Commissioners take the view that if a board of directors is appointed, they should, in fact, direct and be accountable for performance. The appointment and tenure of all management personnel, including the chief executive officer should be subject to the recommendations of the Board of Directors.

Having regard to the scale of the operations of this Corporation, the directors should be administrators and executives of proven competence and experienced in large-scale operations. They should be prepared to spend the time necessary properly to carry out their function and should be remunerated fairly for their services. To provide that the views and interests of various parts of the country and of the several professions and callings specially interested are properly represented, an advisory council might be appointed to consult with the Board periodically.

Unless communications with the government are channeled through a single spokesman for the Corporation there will be danger of misleading the responsible minister and disrupting the internal harmony of the Corporation. Individual appointments as at present serve to encourage separate contacts, since they are interpreted as creating responsibility on an individual basis. A board of directors charged with responsibility should normally designate its chairman or president as the sole contact with senior government.

The nature of the Corporation's task demands that it possess great independence from the political process in the day-to-day conduct of its activities. But this does not mean that it must be handed a blank cheque. Thus, in matters of broad policy governing the shape and nature of the Corporation's development, there is an inescapable responsibility on the government to give guidance. An independent board of directors will normally welcome informal policy guidance and has an obligation to ascertain the views of the government before giving effect to any important change in policy. To make effective a minimal degree of essential control, the minister responsible should have the power to give formal direction to the board. A requirement that such power when exercised be made public would pinpoint responsibility. Experience elsewhere indicates that where such power exists, it is used sparingly, but the existence of the power serves to further a satisfactory relationship between those bearing different parts of the total responsibility.

No account is taken in the foregoing discussion of the future role of the Board of Broadcast Governors. Part I of *The Broadcasting Act* clothes the Board with broad regulatory powers, in the following terms:

10. The Board shall, for the purpose of ensuring the continued existence and efficient operation of a national broadcasting system and the provision of a varied and comprehensive

broadcasting service of a high standard that is basically Canadian in content regulate the establishment and operation of networks of broadcasting stations...

And Section 29 declares that "The Corporation is bound by the provisions of Part I".

In light, particularly, of the emergence of a private television network actively competing with the Corporation, the possible conflict between the powers of the regulatory authority and the statutory terms of reference of the Corporation is assuming serious proportions. Because the resolution of such difference lies entirely within the field of public policy, your Commissioners abstain from comment.

4

ORGANIZATION AND MANAGEMENT

Since its formation in 1936 when it took over the affairs of the Canadian Radio Broadcasting Commission, the Canadian Broadcasting Corporation has experienced rapid and substantial growth. This is illustrated by the following table showing numbers employed at selected dates.

Table 2—CANADIAN BROADCASTING CORPORATION—EMPLOYMENT AT SELECTED DATES

<i>Date</i>	<i>Number of Employees</i>
November 2, 1936	133
March 31, 1940	572
March 31, 1945	920
March 31, 1950	1,375
March 31, 1952	1,565
March 31, 1956	5,022
March 31, 1961	7,502

The large increase following March 31, 1952, is due to the inauguration of television broadcasting, which resulted in the employment of large numbers of technical and production personnel. Changes in organization were made to accommodate this important new activity. Subsequent reviews by the Fowler Commission and Parliamentary Committees further influenced the organizational pattern. The present top organization is set out in Chart 1.

In its simplest form, the operation of a television broadcasting station embraces certain clearly defined classes of activity—sales, engineering and

broadcasting. The latter, sometimes called programming, is divisible into separate functions which include scheduling of programmes; procurement of programmes, by purchase or exchange; and production of the station's own programmes and getting them on the air. The management of a network of stations must take account of these same functions. Some may be performed centrally for the network, others remain local responsibilities. In large networks, management responsibility may be delegated to regional organizations, each responsible for a group of stations. The interplay of national, regional and local activities gives rise to a degree of organizational complexity which, in the case of the Corporation, is compounded by the need to operate not one but two television broadcasting services—one in English and one in French. In addition two distinct radio operations, one in each language, are conducted.

The differences between English and French broadcasting and between television and radio broadcasting are so fundamental that the logical solution would seem to be to set up four separate organizations. However, this is clearly impracticable, first because of the need for consistency of approach in a national broadcasting service and, also, because it would give rise to an expensive duplication of facilities. The organizational pattern of the Corporation, therefore, must accommodate the simultaneous conduct of these separate activities and provide for delegation of line authority in such manner that responsibility for the conduct of each activity may be clearly assigned.

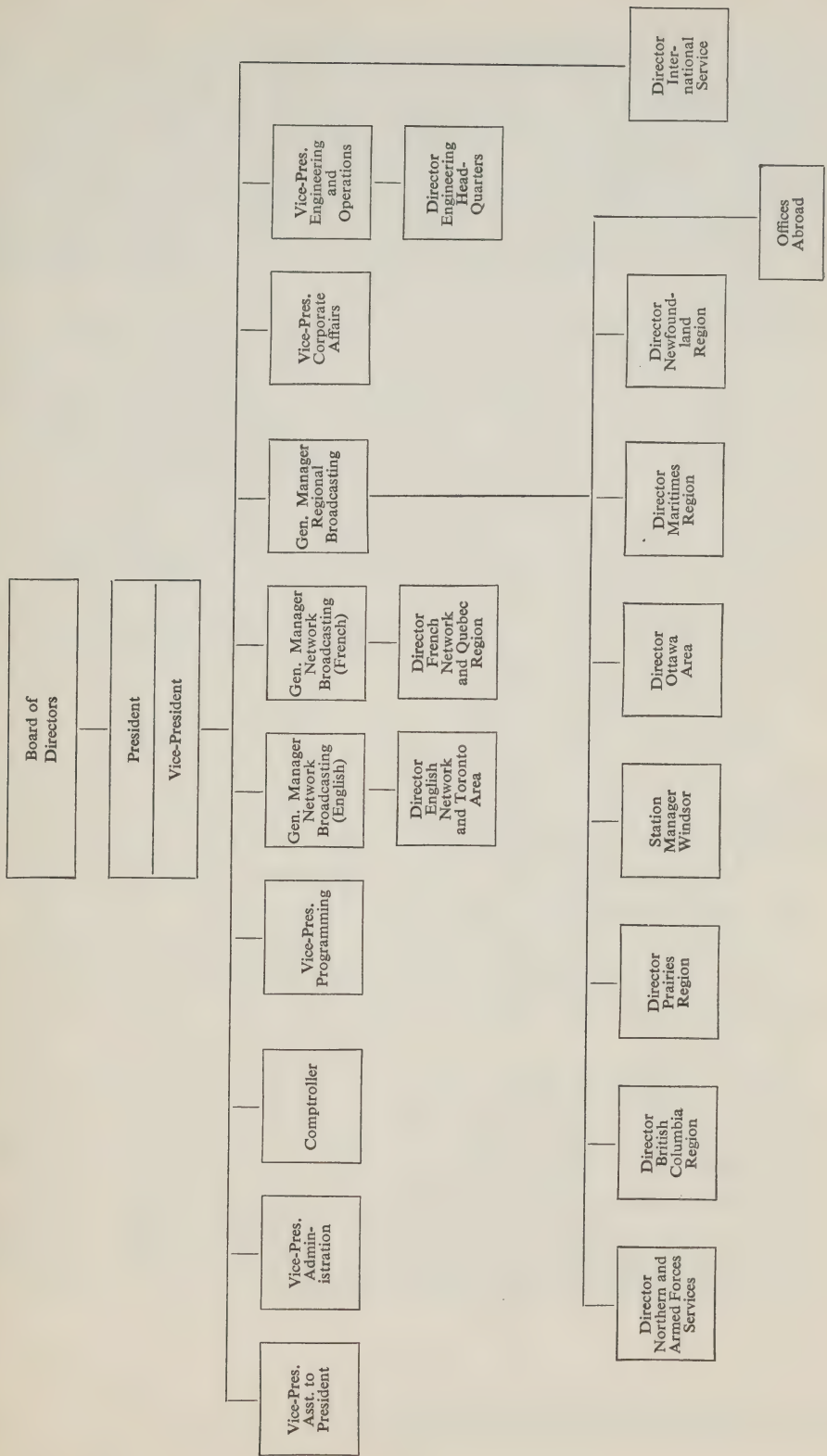
The present organization set out in Chart 1 discloses three separate management levels: the board of directors and executive officers; the headquarters organization; and the regional organization. For present purposes, the chart need not show the station management organization responsible for management of the individual stations.

THE POLICY GROUP

In this group, where corporate policy and major operating decisions are made, the initiative is carried by the President who is the chief executive officer. The Board reviews and approves most of the activities of the Corporation but its role appears to consist largely of ratifying decisions already made, rather than initiating corporate policy. As presently constituted, the Board cannot be expected to act as more than an advisory committee with indeterminate terms of reference and this situation is the indirect cause of much criticism of the management of the Corporation.

The Fowler Commission in 1957 recommended that one senior officer be "mainly engaged in general policy, future planning and public information activities" and that a second senior officer devote himself mainly to "current

Chart 1 - CANADIAN BROADCASTING CORPORATION - PRESENT TOP ORGANIZATION



operations, administration and management." The report of the 1959 Parliamentary Committee, in turn, recommended that a senior officer should be "vested with the clear authority and responsibility for all supervision of production". The intent of both these recommendations was to create under the chief executive officer a senior manager responsible for operations and day-by-day management. The changes made in the organization have failed to accomplish this purpose and the President as chief executive officer remains personally involved in all manner of problems, both of policy and of operating management.

Senior executives are supposed to report to the President on policy matters and to the Vice-President, nominally the deputy chief executive officer, on matters of current operations. In practice, the Vice-President is frequently by-passed in communications between the President and senior executives and his status within the Corporation is affected by the fact that his appointment is made by the Governor in Council without that body being under any obligation to consult with either the Board of Directors or the President.

In the development of corporate policy, the most significant characteristic of the top echelon of the Corporation is the lack of any terminal philosophy or corporate goal. For example, the question of television time on the air, to which reference has already been made, has not apparently been governed by any deliberate policy. Decisions to increase broadcasting have been based on the general desire to provide a greater service and no evidence has been found that cost considerations have played any part in establishing acceptable standards. The policy with regard to securing advertising revenues appears unrelated to specific financial goals and the Corporation has never settled the desirable relationship between cost and commercial revenues. Thus, no consistent commercial policy has been developed. Undoubtedly, the failure to develop long-term financial objectives as a foundation for operating policy is due, in part, to the uncertainties surrounding future finances. Inability to forecast what moneys will be made available from year to year by Parliamentary appropriation has inhibited the development of financial objectives by the Corporation.

The whole problem created by the absence of concrete corporate goals is seriously complicated by the effect of new competition from private broadcasters. The Corporation badly needs a clear definition of its task and the limits of its responsibility. Only on such basis can long-term objectives be established and management aggressively devoted to their achievement. Decision-making in the Corporation would be immeasurably strengthened if a definite pattern of financing were developed, by way of either a fixed annual grant or one based upon Canadian population.

THE HEADQUARTERS ORGANIZATION

Over ten per cent of all employees of the Corporation are found in the headquarters group. With the exception of the engineering headquarters which has always been in Montreal, the headquarters personnel are located in Ottawa. The following analysis shows the numbers attached to the various offices:

Table 3—ANALYSIS OF EMPLOYMENT IN HEADQUARTERS ORGANIZATION

<i>Office of the—</i>	<i>Number of Employees</i>
Secretariat to the Senior Officers and Board of Directors	9
Vice-President—Assistant to the President	83
Vice-President—Administration	115
Vice-President—Programming	92
Vice-President—Corporate Affairs	45
Comptroller	132
Vice-President—Engineering and Operations	48
General Managers	15
	<hr/>
Total resident in Ottawa	539
Engineering Headquarters—Montreal	283
	<hr/>
Total	822
	<hr/>

The management of broadcasting is shared by the three general managers who are respectively responsible for Network Broadcasting (English), Network Broadcasting (French), and Regional Broadcasting. Programming, which is the essence of broadcasting, is treated as an ancillary function under the Vice-President—Programming, who is also responsible for sales policy and planning. Delegated to officials in Toronto and Montreal is the management of the two principal networks. To these same officials and to managers in the other regions is delegated the responsibility for regional and local operation of the Corporation's stations.

If it be accepted that the primary business of the Corporation is to produce and broadcast radio and television programmes, the most striking feature of the headquarters organization is that fewer than twenty people are directly concerned with programming while over 800 are engaged in ancillary operations. It is therefore difficult to resist the conclusion that the headquarters organization is excessively preoccupied with secondary matters, and that the generally high standard of the national programme service is largely attributable to the enterprise and initiative of the network and regional managements.

The present massive Ottawa headquarters results in part from an attempt to respond to the following observation of the 1959 Special Committee on Broadcasting.

Your Committee believes that the process of decentralization of the Corporation's administrative and managerial functions may well have gone too far. The Board of Directors should give immediate consideration to an administrative re-organization and the restoration of clear authority and responsibility to the central headquarters in Ottawa.

Action was accordingly taken by the Corporation but there was no substantive re-organization; a whole new level of management was superimposed on the existing organization, but the effective management of broadcasting remained where it had always been—in Montreal and Toronto. The three General Managers and the Vice-President—Programming were appointed with no clear demarcation of their respective areas of responsibility. Meeting together each week as a programme council, they attempt to co-ordinate their policies, but have little or no real control over the planning and scheduling of network programmes. The duality of authority over network management has the effect of relegating the two Network General Managers to the position of general staff officers to the President and, because there is no separation between network and local programming in Montreal and Toronto, the responsibilities of the General Manager—Regional Broadcasting and the Vice-President—Programming are not susceptible to precise definition.

In carrying out these changes the Corporation failed to give effect to the recommendation made by both the Fowler Commission and the 1959 Commons Committee that a single executive be given clear authority over the broadcasting function. The need for such an officer is self-evident and the responsibilities of the position are such that substantial remuneration will be required to attract a person with the requisite qualities. So long as the headquarters of the Corporation remain in Ottawa, it may be impracticable for the senior operating officer to be stationed elsewhere, although his principal activities will be in Toronto and Montreal, and he will require a highly competent deputy in each of the cities. It would be highly undesirable, however, to build up a large staff around him in Ottawa, because the management of network programming must necessarily be undertaken elsewhere.

The supervision at headquarters of administrative, technical and supporting services is distributed between five officers reporting to the President.

Vice-President—Assistant to the President

Vice-President—Administration

Vice-President—Corporate Affairs

Vice-President—Engineering and Operations

Comptroller

No recognizable pattern or system is evident in the grouping of functions between these officers, and a lengthy and detailed exposition would be valueless because of frequent changes. While the direct lines of operating authority flow through the general managers, there are many staff relationships between head office services and their counterparts in the field. These include legal services, personnel, sales, engineering, purchasing and stores, and public information services. In many areas the functional authority of head office staff and service departments is confused and throughout the Corporation there is a general lack of understanding of the common "line-and-staff" relationship.

One result of the present arrangements is that the ordinary business of corporation management is undertaken by a profusion of committees, which occupy much of the time of the staff at every level of management. The same pattern was observed in regional and area headquarters. A presumption is that the existing organization structure has been developed with the deliberate object of ensuring that, as far as possible, policies are formulated and decisions taken by groups rather than by individuals. This may be a direct consequence of the numerous inquiries and investigations to which the Corporation has been subjected over the years, and an element in the intricately constructed defensive carapace from which all but the most diligent inquiries rebound. Under this system, the President assumes total responsibility (as he rightly should) for all activities of the Corporation, but no one of his subordinates can ever be held answerable for any particular aspect of policy or operations. Apart from the frustration experienced by progressive officers of the Corporation and the confusion that arises in the transmission of decisions, the maintenance of these permanent defences has the effect of diverting an inordinate amount of the attention of senior officers from their proper business.

The size and constitution of the headquarters organization suggests a failure to distinguish between the necessity to centralize the formulation of policy and to decentralize the actual conduct of both primary and secondary operations. In order to exercise authority from Ottawa, it is by no means necessary to concentrate secondary operations in Ottawa; all that is needed is the establishment of clear lines of authority and the unambiguous demarcation of areas of responsibility. Neither of these objectives has been achieved. There is no effective central authority over broadcasting, and an over-zealous control of secondary activities affords no compensating safeguards, while distracting much of the attention of senior officers from the principal business of the Corporation. Many of the present troubles and difficulties would be resolved, and the speed of business accelerated, by an extensive decentraliza-

tion to the regions and a more rational distribution of the control of ancillary operations at headquarters and throughout the organization.

THE BROADCASTING ORGANIZATION

Discussed hereunder is the broadcasting function, the very heart of the Corporation's activities. In terms of management and organization this activity is found by your Commissioners to be less than satisfactory. But in terms of the service rendered the public, the judgment cannot but be favourable. The quality and balance of network programmes has been exceptional and the large audiences catered to have enjoyed a full and edifying fare of cultural, informative and entertaining programmes. Such complaints as are heard from time to time with respect to programme content are, to the extent that they may be justified, attributable to deficiencies in programme control and not to the policy aims of the Corporation.

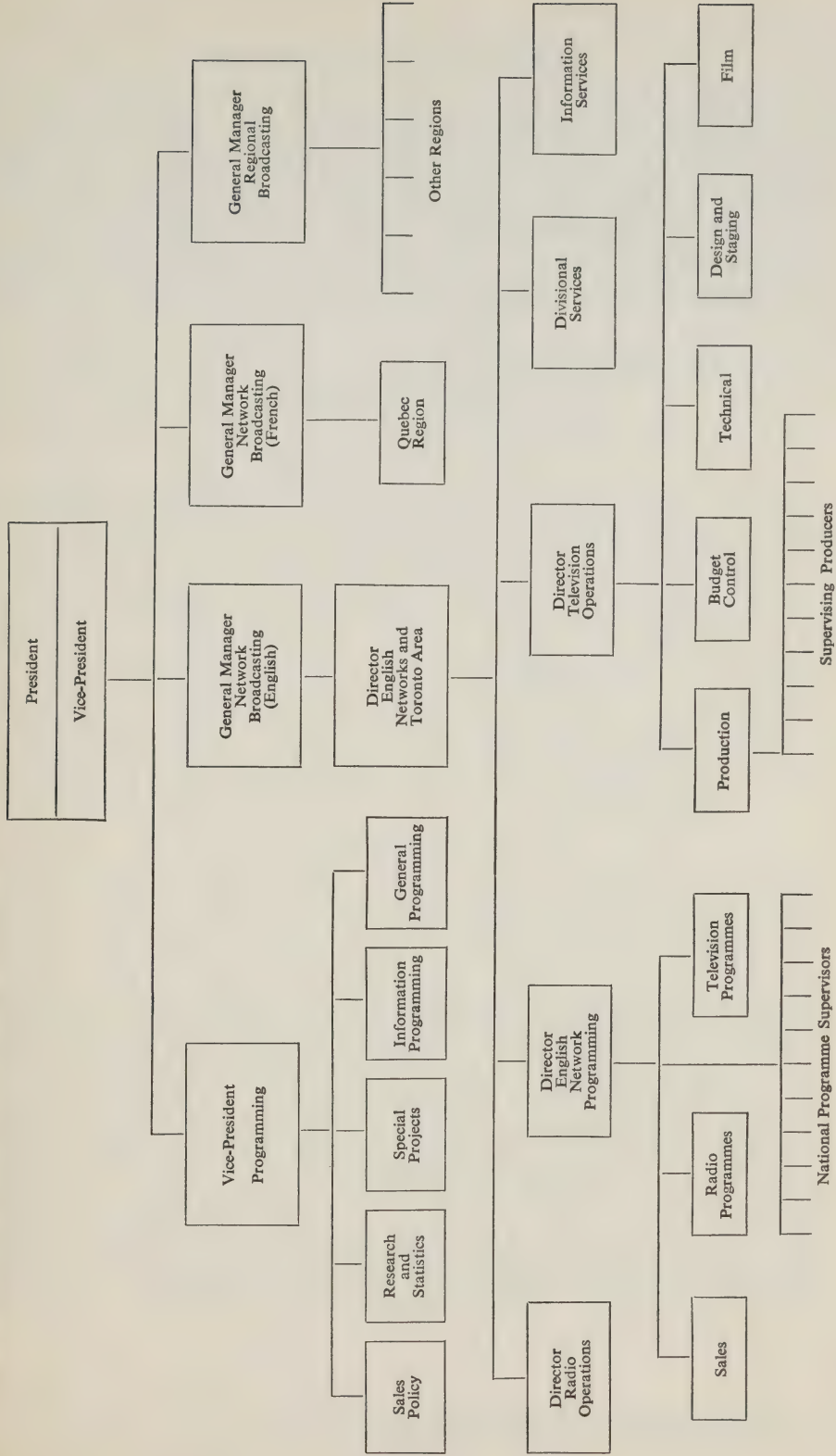
A constant theme within the Corporation is that the complexity of its operations makes it hard for outsiders to comprehend the workings of its organization, but in fact the incoherence of the organization is not a consequence of complex activities; it is due to a failure to analyse them and provide for their co-ordination on tried and established principles.

The broadcasting organization, sometimes referred to as the regional organization, combines within a single framework all the varied functions of the Corporation. National, regional and local operations of both radio and television are indiscriminately scrambled within two principal centres—Toronto for English programmes and Montreal for French. The present pattern of broadcasting operations is shown in skeleton form in Chart 2, which gives the regional arrangements in Toronto. There are some differences in the Montreal organization, and in the outlying regions the distribution of duties is generally less complex.

A simple analysis of the main function performed by the Corporation will facilitate an understanding of its organizational needs. Remembering that operations in the French language require an almost exact duplicate of the organization for English broadcasting, the main components of the latter operations are found to consist of the following distinct functions, each performed in respect of both radio and television programmes:

- Wholesale or national distribution of programmes through networks.
- Operation of broadcasting stations owned by the Corporation and distribution through them of programmes to local audiences.
- Manufacturing, or production and procurement of programmes for distribution through both wholesale and local outlets.

Chart 2—CANADIAN BROADCASTING CORPORATION
PROGRAMMING AND PRODUCTION — PRESENT ORGANIZATION



Wholesale or Network Operations

Broadcasting networks are created by linking together a number of stations to carry common programmes simultaneously. The national broadcasting service referred to in *The Broadcasting Act* relates directly to this sort of operation. The task consists of constructing the network through arrangements with the individual stations, mostly under private ownership, and designing and procuring the programmes to be broadcast. The constitution of the various networks operated by the Corporation is shown by the following table:

Table 4—CANADIAN BROADCASTING CORPORATION

Television and Radio Networks Operated—1961

	<i>Privately Owned Stations</i>	<i>CBC Owned Stations</i>	<i>Total Network</i>
TELEVISION			
English network	55	9	64
French network	9	4	13
	<hr/>	<hr/>	<hr/>
Total television	64	13	77
	<hr/>	<hr/>	<hr/>
RADIO			
Trans-Canada network	95	25	120
French network	34	4	38
Dominion network*	49	1	50
	<hr/>	<hr/>	<hr/>
Total radio	178	30	208
	<hr/>	<hr/>	<hr/>

* Discontinued 1 Oct., 1962.

The procurement of programmes for network broadcast involves arrangements for the use of programmes produced at various points across Canada and for the carrying in Canada of programmes originating in other countries, principally the United States. The network function, essentially a nation-wide operation, also embraces arrangements for long distance transmission of programmes over leased telecommunication facilities. In designing the mix of programmes for broadcast by the networks, a proper balance between different types of programmes is needed and the requirements of regulatory authorities for Canadian content of broadcast services necessitate a suitable balance of programmes from production centres in Canada.

Local Station Operation

The thirteen television and thirty radio stations owned by the Corporation are part of the various networks, but broadcasts of network programmes take up less than half the time these stations are on the air. For the balance of the time each station must round out its own broadcast schedules. For this purpose programmes may be obtained by purchase or exchange or may be produced locally. The best of such productions, particularly those originating in Montreal and Toronto, where extensive facilities exist, are likely to be incorporated in the schedules of the networks. It is to be observed that management of local stations, singly or in convenient groups, is a very different sort of operation from network operation.

Manufacturing or Production

Regardless of the use to be made of programmes, their production is essentially a local responsibility. Production embraces a large number of different techniques—from journalistic gathering and editing of news to pictorial reporting of important events and sporting activities. Generally, in television, the most complex and costly type of production is the presentation of the visual arts through performances undertaken explicitly for broadcasting purposes. Here all the elements of theatrical production are involved—scripts, actors, directors, staging, costuming and so on. In many cases the costs of such productions could not be justified were they not assured in advance of a nation-wide audience through inclusion in network schedules.

Organizational Needs

From the foregoing brief outline of the different activities certain broad requirements for their organization emerge. Apart from the division involved in managing separately the different tasks of radio and television, the principal distinction to be observed is that between the national and local responsibilities—between wholesaling programmes gathered from many sources through a chain predominantly composed of privately-owned outlets, and the complete serving of local audiences wherever the Corporation's own stations are located. A logical organization will therefore require, for both radio and television, separate groups responsible respectively for network and local operation, with functions assigned somewhat as follows:

Network Operation—

- Construction and maintenance of network through dealings with constituent stations.

- Design of network programmes with due regard to a proper balance of different types of programmes and the maintenance of satisfactory standards of taste and propriety.
- Procurement of programmes by various methods.
- Arrangements for transmission throughout the networks.

Local Operation—

- Design of local broadcast programmes.
- Procurement of programmes for local use.
- Production locally of programmes of various sorts, some for local consumption, others destined for network use.
- Maintenance of production facilities.
- Operation of broadcasting facilities.

Reference to the existing organization shown in Chart 2 discloses no such clear-cut divisions. Much of the organizational disarray appears to stem from the attempt to integrate radio and television programming at the network level and from the intermingling of network managements with local operations at Montreal and Toronto. Fragmentation of authority for national programme control between headquarters and the several networks also tends to blur the lines of responsibility.

The resulting confusion in lines of responsibility and authority may be illustrated by the arrangements governing local broadcasting in Ottawa. For general purposes, the Director of the Ottawa area is immediately responsible to the General Manager—Regional Broadcasting at headquarters. As regards the quality and balance of local broadcasting in French, he is subordinate to someone in Montreal who is responsible, at several removes, to the Director of French Networks and Quebec Region, and thence to the General Manager—Network Broadcasting (French) at headquarters. Similarly, for local broadcasting in English, he is subordinate to someone in Toronto who is responsible eventually to the Director of English Networks and Toronto Area, and thence to the General Manager—Network Broadcasting (English) at headquarters. It is little wonder that the Vice-President—Programming finds it difficult to identify and fulfil his responsibilities.

Effective headquarters authority over broadcasting can, in the opinion of your Commissioners, be achieved only by distinctly and factually divorcing from local management in Montreal and Toronto both the national function of programme control and the management of the networks. This does not

imply that these functions should be transferred to Ottawa; indeed, like a number of other activities, they can be performed more conveniently, effectively, and economically in Montreal and Toronto than in Ottawa, so long as they are not subordinated to regional management. Once this necessary separation of responsibility has been effected, it will be possible to define more precisely the authority that should be delegated to the directors of the regions.

ENGINEERING

A special case is presented by the engineering headquarters, which has a staff of around 280, most of whom are stationed in Montreal. Historically, and particularly during the development and inauguration of television services, the Corporation had no option but to establish its own engineering organization, because the necessary technical knowledge and experience were not otherwise available in Canada. High praise is merited by the results that have been achieved, and clearly the Corporation should continue to pursue an active programme of development in the technical areas peculiar to broadcasting. However, now that the crest of the wave of expansion has been successfully ridden, other considerations apply to the more general areas of engineering.

It is questionable, for example, whether the Corporation has a real need for a staff of more than 70 in its Architectural Division, although it is recognized that this number may be currently inflated while the new head office building is being designed. This project is a good example of the type of general engineering work that occurs irregularly and does not justify the maintenance of a large permanent staff. There is a continuing temptation, so long as the staff is there, to embark on projects that may be desirable but are not strictly necessary, merely to justify its existence. The Columbia Broadcasting System in the United States, with a total staff of approximately 12,000, has an engineering staff of only 116 and plans to reduce this number.

In the view of your Commissioners the scope of the Corporation's engineering activities should be limited to those technical areas directly related to broadcasting. Architectural, constructional and other general services required could be furnished by the Department of Public Works or private contractors.

The location of the engineering headquarters in Montreal while all other headquarters staffs are resident in Ottawa appears somewhat anomalous. Because of the relevance of their work to the budgetary and other aspects of headquarters responsibilities, the logical place for the group would be Ottawa. Such a move, however, may not be imperative, as long as satisfactory

working relations can be maintained between the engineering staff and the head office. But it seems to your Commissioners to be essential that, whatever the location of the engineering group, its present separation from the Director of Engineering, who is now situated in Ottawa, should be ended.

SALES ORGANIZATION

A characteristic of the Corporation's sales effort is the previously noted lack of a positive policy with regard to commercial exploitation. Such control or direction as emanates from headquarters is generally negative in nature and the attitudes of operating officials in the field show wide variation. Some disapprove in principle the carrying on of commercial activities—others may be over-zealous in seeking revenue. The advent of strong competition from private broadcasters renders imperative the early enunciation of the Corporation's commercial policy.

It is recognized by the Corporation that every programme available for sale could be sold at a price, but two factors operate against the sale of many prestige programmes of high technical and cultural merit. First, there is what appears to be excessive concern with the risks of sponsor influence on programme content, though this affords no justification for regarding prestige programmes as unsaleable. Second, prestige advertising cannot be directly related to results, and potential advertisers are deterred by the high cost of sponsorship that results from established minimum requirements for programme cost recovery. Your Commissioners believe that the potential sale of cultural programmes to prestige advertisers is not being fully explored, and that the Corporation should reconsider its policy in regard to minimum programme cost recovery.

A sales policy and planning unit was established only in 1960, and has experienced great difficulty in securing consistent data for such common controls as monthly sales analyses and comparisons of revenue with direct sales costs. A pattern of sales control on a national basis is slowly being developed, but nobody at headquarters in Ottawa has any real authority over the sales organization in the field, and instructions are too frequently flouted with impunity.

The sales force of the Corporation is relatively small in comparison with its competitors. For example, a private station in Hamilton has a larger sales staff in Toronto than the Corporation has for national and local sales in the whole of the Toronto area. The chief concern should be with quality rather than quantity, but even in this regard the Corporation is weak. Salesmen are unionized and lack the incentive provided by way of commissions

or compensation based on effort. Sales training and development programmes should be intensified, and the sales remuneration policy reviewed with a view to providing more positive incentives. Close co-operation is needed between sales and programming, for sales cannot be made unless saleable programmes are being produced. But it is wrong to assume that interrelated activities cannot be co-ordinated unless they are directly under common management, and that sales must therefore be subordinated to programming. In each of the two network centres, the Director of Network Programming is responsible for sales, an arrangement which can aggravate excessive commercialism.

Your Commissioners believe that, if the Corporation is to continue its commercial activities and rely on them for a substantial part of its total revenue, the factor that over-rides all other considerations is the necessity of building up a strong sales organization from coast to coast. This can best be done by divorcing sales from regional and network management in all centres, and appointing a General Sales Manager. Under this arrangement, the essential balance between programming and sales should be maintained by budgetary control, which would act as a spur to both elements.

FINANCIAL ADMINISTRATION

Accounting changes made since the publication of the report of the Fowler Commission in 1957 have improved and extended the financial control exercised by both headquarters and the regions. Decentralization of accounts and the preparation of detailed regional reports, showing results in terms of network and station operating costs, now provide valuable control data, and capital and operating costs are compared with budgets on a systematic basis. These developments have resulted in a raising of the status of financial staffs, but not until late in 1960 did the Comptroller become accountable directly to the President. The devolution of accounting control to the regions requires a strengthening of professional aptitudes among the regional chief accountants; many now lack the qualifications or breadth of experience needed to provide effective financial guidance.

The financial planning and budgeting function is currently split between the Comptroller and the Vice-President—Engineering. This dates from the days when competent financial talent was not available within the organization. While a gradual consolidation of these activities is slowly taking place, the present arrangements lead to duplication and waste of effort, particularly in the regions. Apart from the division of authority for budget preparation and supervision, the budgetary procedures reflect an unsound approach. Budgets are based initially on broad estimates by head office, influenced by

results of the preceding year, instead of being developed in the operating centres on the basis of firm programme schedules. They are then submitted to the Treasury Board. Only after the total has been approved are target figures issued to the operating units as a basis for the preparation of detailed regional budgets. As a result, the final budgets are based on what it cost last year plus an estimate of additional requirements, with no searching analysis of last year's costs. They possess, therefore, little real value for purposes of planning as effective instruments of control.

There are further evidences of organizational overlapping in the existence of two systems and procedure groups, one reporting to the Vice-President—Administration and the other to the Comptroller. Similarly, while a “management audit” group was formed in 1960 under the Vice-President—Administration to assist in the assessment of management activities, an internal audit group reports to the Comptroller and performs some similar functions. It would be logical to combine them.

5

CONCLUSIONS

The foregoing discussion of the organization and management of the Corporation does not purport to be an exhaustive review. The critical tone results from reporting only the more important departures from generally accepted practice, and your Commissioners must observe that a complete assessment of performance would necessarily pay high tribute to many of the Corporation's accomplishments in providing Canadian audiences with radio and television services of high quality. Nevertheless, there can be no doubt but that the Corporation is in need of extensive reorganization to secure efficiency and economy in its operations.

No blueprint for the future organization of the Corporation is submitted—indeed, its preparation cannot be undertaken before the future role of the organization has been settled. When that has been done the development of a sound pattern of organization will present no special difficulty. Regardless of the future scope, it is apparent that substantial savings can be effected through the application of tried and proven principles governing the devolution of authority and by establishing the accountability of management in its various functions.

Among government agencies there are two, the Canadian Broadcasting Corporation and the Bank of Canada, which for reasons of public policy are each endowed with statutory independence. Both are incorporated with their boards of directors drawn from outside the public service; and each is charged with responsibilities of direct and substantial significance to the people of Canada. Moreover, both have operations stretching across the

country. In spite of these common attributes, there is great variation between the two in the success attending their managements. The Bank of Canada can be said to be ably administered and effectively organized for its tasks. The Canadian Broadcasting Corporation, in spite of many praiseworthy accomplishments, has failed to develop positive goals. For this and other reasons, its management and form of organization have proved unequal to the task of securing the orderly conduct of operations in the face of the pressures brought about by rapid expansion. A comparison, therefore, of the major differences between these two bodies may well disclose the underlying reasons for variation in the quality of their performance.

A first and important difference lies in the varying nature of the tasks of the two institutions. A central bank is an established type of institution with many models and precedents to guide management. At the other extreme lies the pioneering nature of the task of Canadian Broadcasting Corporation. A second important variation lies in the degree of public interest which attends the performance of each. Sensitivity to public criticism has led the Corporation's management to make changes but these changes undertaken for defensive reasons alone have constituted major errors of organization. The needs of a central bank for guidance in defining its operational scope are minimal. On the other hand, the Corporation has been in desperate need of general leadership on main policy lines as the broadcasting field has expanded. Finally, a significant variation in the competence and capacity of senior executives is apparent. Salary levels of the Bank accord to the scales in private business and as a result it attracts and retains able administrators. The senior levels of compensation in the Corporation are too low in relation to the responsibilities involved. The President receives an annual salary of \$20,000 and the statutory Vice-President \$16,000, both set by the Governor in Council. All senior operating officers are paid less than the Vice-President, with the result that the whole salary structure of the Corporation is undesirably compressed at senior levels. It is not uncommon, for instance, to find a differential of no more than \$200 or \$300 a year between senior officers and their immediate subordinates—a situation that provides virtually no incentive to seek promotion and heavier responsibilities. There is a real need for more latitude and flexibility in selecting fully qualified and experienced men for senior positions. To provide the salaries which must be paid, there is need of a substantial increase in the salaries of the chief executive officers, and the Board of Directors (as your Commissioners visualize the Board) should have authority to determine the remuneration of these officers in the future. Your Commissioners are satisfied that in the face of competition for skilled

senior personnel by private broadcasters in Canada and abroad, present remuneration practices cannot be expected to attract the men of competence and experience needed to fill the senior posts.

The broadcasting function is one which clearly cannot be performed by a department of government and the employment of a Crown corporation for the purpose is appropriate. If the heavy responsibility of its operation is to be borne by a Board of Directors, the membership of the board must be carefully chosen and include persons qualified by experience in large undertakings, devoting sufficient of their time properly to discharge the obligations assumed. While the chief executive officer may properly be a member of the board of directors, he should never dominate it and his continued employment should be subject to the board's approval of his management.

No matter how strong or capable a board may be assembled, there will remain a need for policy direction from the government. This can normally be accomplished by informal means but, as a fundamental protection, the minister responsible should have the power of formal direction. Such a plan offers no threat whatever to the integrity of the Corporation's programme activities, for which the Board of Directors must assume full responsibility.

Reference was made earlier to the unsettled relations between the Corporation and the Board of Broadcast Governors arising from ambiguity in the present legislation. Your Commissioners offer no suggestion as to how this problem should be resolved but they observe that a clear definition of the authority and responsibility of each body is one of the requisites for the development of clear policy goals by the Corporation.

20 DEPARTMENT OF NATIONAL DEFENCE

SPECIAL AREAS OF ADMINISTRATION

REPORT 20: DEPARTMENT OF
NATIONAL DEFENCE

PUBLISHED BY THE QUEEN'S PRINTER • OTTAWA • CANADA FOR
THE ROYAL COMMISSION ON GOVERNMENT ORGANIZATION

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In addition, Mark McClung, B.A.(ALBERTA), B.A.(OXFORD), Research Co-ordinator on the Commission's staff, assisted in an editorial and co-ordinating capacity.

A number of submissions bearing on this topic were received from individuals and organizations; these have been carefully considered and are noted in our final report.

Your Commissioners, in acknowledging the assistance and advice received from the above-named persons, dissociate them from any of the findings and conclusions contained in this report; for these, your Commissioners assume full responsibility.

1

INTRODUCTION

The dramatic change that has taken place in the level of federal expenditures since 1939, a twelve-fold increase, has two main sources—the broad enlargement of social services and the development of a peacetime defence organization on an unprecedented scale. Immediately after the end of World War II, defence expenditures fell sharply and it appeared that a return to the relatively minor dimensions of traditional peacetime expenditure was in prospect. However, the crisis in Korea and Canada's developing commitments to NATO, NORAD and the United Nations resulted in a greatly enlarged defence effort. From a total of \$385 million in the fiscal year 1950, defence expenditures increased to \$1,652 million in 1961-2. For the first time in the history of Canada in peacetime, there are over 125,000 serving in the Armed Forces, with almost 50,000 civilians also employed. Table 1 shows defence expenditures (including defence purchasing costs and civil defence) and Service manpower from 1950 to 1962.

In this inquiry, the Department of National Defence has been singled out for a number of reasons. The most obvious are its size, the range and cost of its activities, and the impact of Western defence alliances. Moreover, the composition of the department is unique, consisting as it does of two elements, military and civilian, differing in status, rank structure and terms of employment, although they function as an entity. Also of significance is the character of the Armed Forces, whose numbers, organization and skills are predicated on wartime tasks, with the consequence that utilization in peacetime is a problem.

Table 1—DEFENCE BUDGETARY EXPENDITURE AND SERVICE MANPOWER—ALTERNATE YEARS

Year ending March 31	Defence Budgetary Expenditures	Service Manpower at Year-end
	(millions)	(thousands)
1950	\$ 385	47.2
1952	1,447	95.4
1954	1,858	112.5
1956	1,768	116.7
1958	1,687	119.0
1960	1,537	119.6
1962	1,652	126.5

The \$1,652 million spent in 1961-2 by the Department of National Defence (including the Defence Research Board) and for defence purchasing and civil defence represented 25 per cent of total federal expenditures, but defence activities in terms of employment, equipment and other operating costs accounted for an even larger proportion of federal government operations. Excluding statutory grants, payments to provinces and debt service, the remaining expenditures of the Government of Canada on its own operations in 1961-2 were less than \$4,000 million, of which more than 40 per cent is accounted for by defence spending.

The scale of defence expenditures lends particular importance to the principles set forth by your Commissioners in the report on *Financial Management*, relative to the administration of financial business throughout the government. Subject to special considerations, these principles are fully applicable to the conduct of business by the Armed Forces.

One of the principal recommendations of your Commissioners in the report on *Financial Management* is that departmental Estimates be prepared on the basis of programmes of activity rather than by standard objects of expenditure. In Part 2 of that report, Exhibit 13 and succeeding illustrations demonstrate the types of programme differentiation appropriate to certain activities in the Department of Transport. In the Department of National Defence, some difficulty may be anticipated in developing an appropriate programme classification, because the programmes and responsibilities of the several Services overlap and many of the special commitments call for joint activity. Until there is greater co-ordination of support functions, it will be essential, for purposes of control and assessment, to programme separately identical functional activities of each of the three Services.

The programme classification for defence expenditures should be designed for the most effective achievement of two main objectives—first, to permit the

control of expenditures in an orderly manner, including regular comparisons of actual against estimated costs, and second, to present a significant and informative breakdown of Service expenditures in the Estimates and Public Accounts. Once a satisfactory programme classification has been developed, the cost elements of individual programmes should be consolidated within a single Vote.

The Department of National Defence differs from other departments in another important respect. Here, as elsewhere, the financial control of Parliament rests upon the regulation of the volume of cash expenditures. The Armed Forces, however, possess very large inventories, the estimated value of which ranges from \$500 million to \$750 million. By building up or drawing down these huge quantities of material, the variation between real cost and cash expended in any period may be much greater than in other departments. To this extent, Parliamentary control is less effective.

The recommendation, in the report on *Financial Management*, that departmental accounting be designed, using the accrual method, to serve the actual needs of departments is particularly relevant to the accounts of the Armed Forces. Conforming to the programme classification to be designed, the accounts of the Department of National Defence will facilitate the preparation of budgets on a cost basis rather than on a cash basis. Comparison of results with budget, month by month, will lead to early detection of important variances. Accrual accounting will automatically reflect variations in military inventories—the principal danger-point in the present cash system. However, a distinction will necessarily have to be made between those inventories of combat consumables acquired for war use and those of an operating or maintenance nature. Because of the high obsolescence of warlike equipment, its cost should be absorbed as it is received, while ordinary operating materials and consumable supplies should be chargeable to operations as they are withdrawn from store.

Nearly half the total expenditure on defence represented payments to or for personnel, and the total wage bill for defence was slightly more than that of all other departments together. In September, 1960, uniformed personnel of the Armed Forces constituted 26 per cent of the 465,998 persons composing the public service in its widest definition, and civilian employees of the Department of National Defence represented 26 per cent of the total employed by departments of government. Defence accounted for 87 per cent of all government expenditures in 1961-62 on the acquisition and upkeep of equipment, and for nearly 60 per cent of the total expenditure on materials and supplies. The Armed Forces manage 6 million acres of land within the provinces of Canada, and occupy over 140 million square feet of floor space

—about 80 per cent of all space owned and leased by the government. The principal elements of the 1961-2 defence budget are shown in Table 2.

Table 2—DEFENCE EXPENDITURES 1961-1962

<i>Class of Expenditure</i>	<i>Defence Expenditures</i>	<i>Percentage of all Government Expenditures of same class</i>
	(millions)	
Personnel Costs:		
Members of the Forces	\$540	100
Civilian Employees	200	22
Superannuation charges	65	48
Equipment—acquisition and upkeep	475	87
Buildings and Works—		
Acquisition and upkeep	120	27
Materials and Supplies	108	59

The position of the defence departments and agencies, as the biggest spenders by far in government, inevitably brought their activities under review by several of the groups investigating specific aspects of government activity for your Commissioners, and many of the reports dealing with these activities discuss the position of the Armed Forces in each particular context. This report treats exclusively with phases of defence organization—in particular, the need for better co-ordination of activities common to the three Services, and for more effective application of manpower.

More detailed information about the developments of the past ten years is given in the accompanying appendices. Appendix 1, using selected years, reflects the growth of Service strength since 1950, and Appendix 2 lists the expenditures by each of the Services year by year. These figures show that the Royal Canadian Air Force has grown most rapidly and is now three times as large as it was twelve years ago; its expenditures to-day exceed those of the Army and Navy together. Appendix 3 shows a breakdown of the National Defence dollar from 1951 to 1962 by major cost categories.

The object of this study is not to examine Canadian defence policy, but to appraise the role of the Department of National Defence in the formulation and application of policy and the suitability of its present organization in these roles. Attention is therefore focussed on the headquarters organization and on the broad aspects of administration. It is recognized, however that recommendations advanced to promote efficiency currently, must at the same time be evaluated in the light of their possible effect on the operational effectiveness of the Armed Forces.

2

ORGANIZATION FOR DEFENCE

The principal task of the Department of National Defence is to implement the defence plans of the Government of Canada. The formulation of those plans rests with Cabinet and although the Minister of National Defence is primarily concerned, many factors of importance to other ministers must be taken into calculation—including international relations, costs, and the impact of defence expenditures on the domestic economy and the balance of international payments. Moreover, only the Cabinet is competent to evaluate public opinion relating to defence.

Because of these considerations, there has long existed a Cabinet Defence Committee which is assisted by the deputy ministers principally concerned, the Chairman of the Defence Research Board and the Chiefs of Staff of the Armed Forces. On the latter falls the duty of advising on the nature and strength of the military forces that may constitute a threat to Canada, and of proposing military measures to counter that threat, for consideration by ministers in the light of the other factors noted.

THE BASES OF ORGANIZATION

In organizing the Department of National Defence for the execution of defence programmes, two facts are of prime significance:

- Canadian defence arrangements do not envisage independent military action by the forces of this country.

- The forces to be used in meeting any major emergency must be organized, equipped and trained before the emergency arises.

The Collective Basis of Defence

Canadian forces today are designed primarily to operate under collective arrangements—in NATO, NORAD and “police” activities of the United Nations. This fact, taken in conjunction with the necessarily modest size of the Canadian part in these arrangements, has two consequences of importance to the organization of the military establishment.

First, the task of the Armed Forces consists of a number of separate missions with little direct relationship to one another although forming, for the most part, segments of a single pattern of defence for the participating countries. The object is to achieve a balanced *collective* effort, rather than a balanced and integrated Canadian defence establishment. Considered by themselves, therefore, Canadian forces necessarily present a fragmentary appearance.

Second, the lines of operational command for Canadian formations assigned to the various missions lead to international commands such as the Supreme Allied Commander in Europe (SACEUR) and Supreme Allied Commander on the Atlantic (SACLANT) in NATO, the joint Canadian-U.S. North American Air Defence Command (NORAD) or, for United Nations police actions to commands established by the world organization. Canada participates in the collective control and direction of these international commands but, once its forces are committed to their missions, exercises little direct control over operations.

Consequently, the principal function of the headquarters organization in the Department of National Defence is one of support rather than operational command—to direct and regulate the manning, training, arming, supplying and accommodating of the Armed Forces, and to provide health and welfare services. In some of these matters the paramount consideration is the mission; in others, each of the three Services will experience needs which are common to its various missions and distinguished from those of the other Services; but in other respects, the task of support will be common to all elements of the Armed Forces. Consequently, the organization of the supporting functions necessarily varies from one to another.

A further consequence of the collective basis of Canadian defence plans has been to create rigidities in the defence establishment. Significant reductions in the strength of the Armed Forces or reallocations of resources for defence purposes can be made only by changing Canadian commitments within the collective defence systems. Unforeseeable commitments, such as

the contributions to United Nations operations in the Gaza Strip and Congo, have had to be met by combining the forces and, to some extent, risking a weakening of resources earmarked for other commitments.

The rigidities in the defence establishment also have important budgetary effects. Given the relatively inflexible commitments of the defence forces, any significant curtailment of expenditure plans is likely to bear unevenly on the various elements of the defence budget. Costs of military personnel and of operation and maintenance are relatively uncontrollable; thus any curtailment tends to fall on the more controllable items, especially equipment purchases.

The "Forces-in-Being" Concept ✓

The other basic fact of relevance to the organization of the defence establishment is that initial commitments will be met, in any future emergency, with the forces immediately available. The experience of the past—in which regular peacetime forces were maintained as a nucleus around which a war-time force could be built through a fairly protracted process of mobilization, training and equipping—is no longer considered to be valid.

One consequence of this new concept is to simplify, in a sense, the organizational problem of defence. There is no need to plan directing establishments for hypothetical forces and to maintain nominal elements of these establishments at a level which makes any realistic peace-time deployment impossible. Under the new concept, each component of the Armed Forces can be designed for a task of known dimensions and given the resources needed to do its job.

Moreover, the test of each component of the Forces is its ability to perform its wartime task virtually without notice. The structure and procedures of the headquarters establishment must therefore be such as to enable it to discharge its responsibilities in the most economical and efficient manner consistent with its obligations to the combat formations under operational conditions.

DIRECTION OF THE ARMED FORCES

The Armed Forces are regulated by the *National Defence Act* and a multiplicity of regulations made by the Governor in Council and the Minister of National Defence under the authority of that Act or by virtue of the Royal Prerogative.

The Minister of National Defence has by statute "the control and management of the Canadian Forces" while each of the three Chiefs of Staff is responsible for "the control and administration" of his own Service "subject to the regulations and under direction of the Minister". Thus, governed

by civil authority only at the most senior level, each Service enjoys a high degree of independence.

The basic factors affecting the organization for defence, noted in the preceding section, apply equally to each of the three Services. Each has only certain designated missions within international arrangements for collective defence; the principal function of each is the support rather than the command of operational formations; the "forces-in-being" concept applies to each.

Although no western country has yet achieved unification of its Armed Forces, doubts have been raised in all countries in recent years about the traditional Service basis of organization. Combined operations are becoming the rule rather than the exception, with each mission requiring the participation and close cooperation of all three Services. Operationally, the anti-submarine forces of the Royal Canadian Air Force bear a much more distant relationship to the Air Division in Europe or the air defence forces under NORAD than to the anti-submarine forces of the Royal Canadian Navy; both elements operate, in the North Atlantic, under the command of SACLANT.

However, the very fact that the Air Force and Navy are support rather than command organizations renders the idea of unification irrelevant in this situation. Moreover, it remains generally true that the combat soldier, the seaman and the airman require radically different training and equipment, and for these aspects of the task of support the three Services still provide, to a large extent, a workable basis of organization.

Nevertheless, the significance of the distinctive operating environments is declining rapidly with the development of defence technology. Not only is the relative size of the "administrative tail" growing steadily in all military forces—for budgeting, accounting, supply, construction and general administration; in addition, among the operational elements themselves there is a rapid increase in the technical content of the work, a large element being common to all three Services. Consequently, there is a growing range of activities of common concern to the Services, for which the traditional basis of organization is unsuited. It is increasingly recognized that to maintain three separate organizations for such functions is uneconomic. Moreover, the chronic scarcity of many of the skills involved cannot be ignored.

The traditional pattern also aggravates the rigidities in the defence establishment resulting from collective arrangements. It has meant, for example, that in finding signallers for the Congo at short notice, the Canadian Army could look only to its own resources in the Royal Canadian Corps of Signals, having no access to the large reservoir of communications personnel in the other two Services.

Thus, regardless of whether or not a case can be made for unification, there are strong reasons for seeking a greater integration of those functions common to the three Services.

TRI-SERVICE INTEGRATION

The integration or consolidation of common functions can be attempted in four different ways, the first two being based on the assignment of operating responsibility to a single Service, the other two involving the removal of direction from the direct control of any individual Service.

Integration under a Single Service

The first and most limited arrangement involves the assignment of responsibility for a particular service, on a local basis, to the major user in the locality. A commonplace example may be seen in the tri-service laundry in Halifax, operated by the Navy but designed to meet the needs of Army and Air Force units in the area.

The British Forces have given increasing attention to this method of achieving consolidation, and your Commissioners are of the opinion that it will yield significant gains in efficiency and economy if applied in such forms as local arrangements for the pooling of vehicle operation and maintenance. It has the merit of simplicity, requiring as it does no significant organizational change. It also allows the assignment of responsibility for any single activity to be varied from one locality to another, depending on the relative needs of the three Services in each case.

The second arrangement involves a general assignment of responsibility to a single Service, which may or may not be the major user. The principle here is not new, for postal and dental services have long been consolidated on this basis and more recently the integration of rationing services has been developing in the same manner, under the Royal Canadian Army Service Corps. The direct line of authority from the responsible Chief of Staff is unambiguous under such arrangements and he is directly answerable to his two opposite members for the efficacy of the service provided. In general, this works satisfactorily.

However, the number of functions that lend themselves to consolidation under a single Service, either locally or generally, is limited. Where a function is vital to the combat effectiveness of a Service, the latter is understandably unwilling to rely on another Service which has its own competing claims for the resources available. This resistance is accentuated where the skills involved in the function, although basically similar for the three Serv-

ices, must be applied to significantly different operational tasks. This objection is particularly relevant to the growing range of common technical functions—such as electrical and mechanical engineering, supply, medical services, and scientific research and development.

Co-ordination by Committee

In the face of such objections, the most common response of the Armed Forces has been to seek co-ordination rather than integration of common functions. The instrument under which co-ordination has been sought is the Chiefs of Staff Committee.

This Committee is composed of the three Chiefs of Staff and the Chairman of the Defence Research Board, with an independent Chairman (currently an Air Chief Marshal). The Deputy Minister of National Defence and the Co-ordinator of the Joint Staff attend meetings, but are not members. The current terms of reference of the Committee are:

- To advise the Minister of National Defence and the Cabinet Defence Committee on matters of defence policy and prepare strategic appreciations and military plans as required;
- To be responsible for co-ordinating the efforts of the Armed Forces in the fulfilment of a single defence policy;
- To be responsible for over-all policy direction of joint Service organizations, establishments (such as National Defence College) and operations; and
- To investigate and consider in common all matters which may be referred to the Committee by the Minister of National Defence or the Cabinet Defence Committee.

The Committee normally meets weekly, and the members collectively consult with the Minister of National Defence at frequent intervals. There is no provision for voting, and no overriding authority is vested in the Chairman. Recommendations and decisions of the Committee must therefore be unanimous; in the event of disagreement, the Chairman reports the conflicting points of view to the Minister, who may then exercise his authority at his discretion.

Thus the effectiveness of the Chiefs of Staff Committee as an executive authority is, to a large extent, dependent on the personal qualities of its members, each of whom has a virtual power of veto in its deliberations. The same pattern is followed throughout the co-ordinating organization that has evolved under the Committee—encompassing more than 200 standing tri-service committees. Although the business of the Chiefs of Staff Committee appears to be conducted with reasonable dispatch, your Commissioners observe that, in general, the system permits procrastination, and the absence of a single commanding voice may spell the difference between success or failure in any matter of joint concern to the three Services.

Integration under Committee Direction

Where an attempt is made to move beyond co-ordination to integration, the weakness of the committee basis of direction persists. When it was decided in 1958 to consolidate military medical services outside the direct authority of any one of the Chiefs of Staff, the Surgeon General was made responsible to the Personnel Members Committee comprising the Chief of Naval Personnel, the Adjutant General and the Air Member for Personnel. As an executive authority, this Committee has all the defects of the Chiefs of Staff Committee in aggravated form. Procrastination and inter-service disagreements, amounting to a virtual refusal to accept direction, have proved formidable obstacles to progress.

A similar experience is noted by your Commissioners in the report on *Telecommunications*, involving the unsuccessful attempt of 1950 to develop an integrated teletype relay system under tri-service committee direction; the lack of an effective executive authority in that case led to the abandonment of the attempt at consolidation and the development of three wasteful and increasingly inadequate networks.

It is the opinion of your Commissioners that effective consolidation cannot be based on joint control by the three Services with the object of preserving the traditional responsibility of the three Chiefs of Staff for the control and administration of all the Armed Forces.

For example, in the report on *Real Property*, it is recommended that construction and real property management for the three Services, which involve thousands of employees and annual expenditures of over \$60 million, be transferred to a single organization. An operation on this scale is singularly unsuited to management by a committee. The same consideration applies to most of the technical activities susceptible of consolidation as well as to such functions as budgeting and accounting.

Integration under Independent Direction

The fourth course available involves consolidation under a single executive authority independent of the three Chiefs of Staff. There are, in fact, precedents for this approach: technical inspection to ensure the acceptability of material ordered by the Services has been consolidated under the Controller-General of Inspection Services, and legal services under the Judge Advocate General—both of whom report to the Deputy Minister. The same principle is involved in the assignment to the Defence Research Board—with separate membership in the Chiefs of Staff Committee—of responsibility for the conduct or direction of scientific research on behalf of the three Services. This arrangement is examined more fully elsewhere in this volume,

in the report on *Scientific Research and Development*.

The three Services sometimes view this method of consolidation with some suspicion, referring to it as "the fourth service concept". It does escape one of the principal objections to consolidation under a single service: the fear of reliance, for an essential function, on another Service which may be pre-occupied with its own competing needs. But the idea persists that operational effectiveness is endangered where the Service loses full administrative control of essential functions.

✓ However, in view of the essentially supporting role of the directing organizations of the three Services, the principle of unified operational command would be unaffected by the integration of common functions under independent executive direction. The historic existence, within the Army, of separate technical corps—the Royal Canadian Corps of Signals, the Royal Canadian Army Service Corps, the Royal Canadian Electrical and Mechanical Engineers, etc.,—has not frustrated unity of command in operations. Nor has the employment of elements of the three Services in combined operations presented any insuperable problems of command effectiveness.

Your Commissioners are of the opinion that the most promising approach to consolidation lies in this method: integration under independent direction by a single authority.

This raises the question: where is responsibility to be placed? The two most obvious possibilities, in virtue of their direct relationship to the Minister and independence from the three Services, are the Chairman of the Chiefs of Staff Committee and the Deputy Minister. The roles of these two officers, and the part they might play in a strengthened organization for defence, are examined in the two succeeding sections.

THE CHAIRMAN, CHIEFS OF STAFF

It was noted above that the position of Chairman in the Chiefs of Staff Committee (C.C.O.S.) carries with it no overriding authority to take decisions. Nonetheless, during the decade since an independent Chairman was first appointed, the occupant of this position has had a pre-eminence not merely in rank, but by virtue of his functions as well.

Under the *National Defence Act*, the C.C.O.S. is required, "subject to the regulations and under the direction of the Minister":

- To act as chairman of a committee composed of the Chiefs of Staff and such other members as the Minister of National Defence may designate;
- To co-ordinate the training and operation of the Canadian Forces;
- To perform such other duties as may be assigned to him by the Minister.

The C.C.O.S. has been designated Canadian military representative to NATO and represents Canada on the Military Committee of that organization. Within Canada, he is chairman of the Ranks Structure Committee, and a member of the Panel on Economic Aspects of Defence, a committee of senior officials serving Cabinet and the Cabinet Defence Committee.

In relation to the key function of the Chiefs of Staff Committee of advising the Minister and the government on military aspects of defence policy, the C.C.O.S. has no formal pre-eminence and there may be merit in making this function the collective responsibility of the Committee. Excessive concentration of the advisory task in the hands of one man has obvious dangers. The actual influence of the C.C.O.S. or of any other member of the Committee depends largely on the personalities of both the Service chiefs and ministers involved in the relationships. But the position of the C.C.O.S. is weighted by the character of his functions—especially by his responsibility for relations with the senior NATO military authority—and by the fact that he is unlikely to be regarded (whatever the Service of his career may have been) as a spokesman for the interests of one particular Service.

In his second statutory duty of co-ordinating the training and operations of the Canadian Forces, the Chairman's lack of overriding powers has greater significance. Since each of the three Chiefs of Staff is responsible for the "control and administration" of his own Service, only "subject to the regulations and under the direction of the Minister", the C.C.O.S. must rely on persuasion and, if this fails, on the willingness of the Minister to be guided by his judgment. It is the opinion of your Commissioners that the role of the C.C.O.S. should be more positive in relation to the affairs of the Services. One way to accomplish this would be delegation by the Minister of more powers of direction to the C.C.O.S.

Of particular relevance to the integration of common functions is the third duty of the C.C.O.S.: "to perform such other duties as may be assigned by the Minister". It is the view of your Commissioners that, by virtue of this provision, the C.C.O.S. should be given the "control and administration", on a consolidated basis, of such elements of the Canadian forces as the Minister may designate. The elements to be considered are those involving technical functions that are of significance to the operational effectiveness of the forces: engineering, telecommunications, supply and transportation, and the integrated medical service.

The direction of the Air Transport Command should also be reviewed in this context. Although a component of the Royal Canadian Air Force, the duties of this Command relate also to the other two Services, and particularly to the Army. It is, in fact, the leading example of an integrated operation

meeting tri-service needs under the executive control of a single service. In view of its potential significance to the operational effectiveness of the Army especially, the present arrangement is open to question. Transfer of executive control to the C.C.O.S. should therefore be considered.

The assumption of such responsibility by the C.C.O.S. would obviously be undertaken by stages, with the necessary direction and impetus provided by the Minister. Moreover, the consolidation of any single function need not be absolute, any more than the existence of the Royal Canadian Corps of Signals prevents the infantry and artillery from operating forward area communications.

- We therefore recommend that:*
- 1 Provision be made for the exercise by the Chairman, Chiefs of Staff, of the ministerial power of direction over the Armed Forces, within such limits as the Minister may define.
 - 2 The Chairman, Chiefs of Staff be given the "control and administration" of such elements common to two or more Services as the Minister may designate.
 - 3 In recognition of the change of status implicit in these proposals, the title of the Chairman, Chiefs of Staff be altered to "Chief of Canadian Defence Staffs".

THE DEPUTY MINISTER

The *National Defence Act* provides for the appointment of a Deputy Minister, but makes no reference to his functions. Consequently, the powers and duties of the office rest on the same basis as do those of all other deputy ministers.

Under the *Civil Service Act*, deputy ministers are assigned the oversight and direction of departmental staffs and the general control of the business of the department, "subject to the directions of the head of the department".

In the Department of National Defence, however, this is subject to qualification. The *National Defence Act* assigns to each of the Chiefs of Staff the control and administration of the Service under his command, subject to such directions as the Minister may give. Consequently, the general oversight and direction vested in the Deputy Minister by the *Civil Service Act* is exercised subject to the limitations set out in the *National Defence Act*.

On the other hand, the Deputy Minister, unlike a chief of staff, is declared by law to be “the lawful deputy” of the Minister. The Minister’s powers being general, it is within his discretion (subject to the regulations and decisions of the Governor in Council) to charge the Deputy Minister with the execution of such functions and duties as he sees fit, provided these are appropriate to the status of his senior civilian officer. However, it is generally accepted that the reaching of a policy decision, involving a minister of the Cabinet, may not be delegated to a deputy minister who, constitutionally, is not accountable to the House of Commons. It is accepted that a deputy minister may exercise extensive powers in giving effect to policy decisions after these are taken by appropriate authority.

Thus, the role of the Deputy Minister of National Defence is determined by the Minister, who may assign a variety of functions so long as they fall within these statutory and constitutional limitations. In the past, the deputy minister’s general control of the business of the department has generally been considered to extend to what have been regarded as the “civilian functions”:

- The final preparation and approval of the annual budgetary estimates before they are placed before the Minister;
- Supervision of the expenditure of moneys appropriated to the Department by Parliament;
- The making of financial arrangements for the Department;
- Review of Service requests (“contract demands” and “requisitions”) for the purchase of equipment, supplies and contract services;
- The audit of stores.

In addition, it is accepted that the deputy minister should participate—without control or responsibility—in the determination of personnel establishments and the formulation of construction programmes. As was noted, two ancillary functions—the Inspection Services and the organization of the Judge Advocate General—have also been placed under him.

Proposals made by your Commissioners in other reports would extend these traditional functions of the deputy minister in several respects. In the report on *Real Property* it is recommended that an organization be established under his supervision to manage the acquisition, construction and operation of real property of the classes now within the control of the Department and the Armed Forces, which would take over the functions

and personnel of Defence Construction (1951) Limited.

In addition, in Part 2 of the report on *Financial Management*, reference is made to duplication of audit functions within the Department of National Defence. The Service audit personnel, numbering 600 with annual salaries of \$2,330,000, are mainly engaged in auditing stores, and the extent of the verification performed goes well beyond what may be regarded as necessary. Your Commissioners believe that all audit functions should be performed by civilian personnel of the Chief Auditor's Branch under the deputy minister.

The statutory responsibility of the Chiefs of Staff for the control and administration of their Services necessarily affects the way in which the deputy minister discharges his responsibility, since there can be overtones of military effectiveness in almost any judgment of administrative efficiency. As a result, the administration of the department requires a continuous and close working relationship between, on the one hand, the deputy minister and his officers, and on the other, the Service Chiefs and their officers. The ultimate authority and responsibility is ministerial, and it is at this level that the relative roles must be decided.

In the opinion of your Commissioners, the role of the deputy minister is at present too narrowly circumscribed in practice, with the result that the Minister does not receive the staff assistance he requires in discharging his responsibility for the direction of the Canadian defence establishment. A number of considerations lead to this conclusion.

The first of these is the need to maintain the historic principle that the Armed Forces are subject to the civil power. Civilian control means, of course, control by ministers answerable to Parliament. In matters of defence policy, as pointed out at the outset of this chapter, the control and responsibility are shared by all ministers, and machinery is available to make that control effective. In the "control and management" of the Armed Forces, however, the primary responsibility rests with the Minister of National Defence. Given the present size and complexity of the Armed Forces, the minister must have strong support if he is to discharge this responsibility effectively.

The Minister may rely primarily on the Chiefs of Staff Committee for advice and on questions of military effectiveness it is natural that he should do so; but the military character of this group raises doubts as to the reality of civilian control if the minister places excessive reliance upon it. There is thus a need for a strong staff group which is essentially civilian in character, outside the framework of management of the Armed Forces. This group should have a sufficiently intimate knowledge of the administration of the Services to enable it to assess the standard of management and advise the

minister of changes in organization or methods of operation that appear to be needed.

A second factor points to the deputy minister's organization as the logical source of such advice; the traditional functions of the deputy minister in such matters as budget, expenditures, establishments and audits provide the principal means of detecting organizational and administrative weakness. The deputy minister thus has, at his disposal, the necessary basis of assessment and advice—subject to some strengthening of his role in respect of Service establishments, as discussed in the next chapter.

A third consideration is that the division into three Services, which is basic to the management of the Armed Forces, does not affect the deputy minister's organization. His staff are therefore free of the traditional inter-Service rivalries and better able to take a comprehensive view of defence organization and administration. This is obviously of major relevance to the task of developing greater integration of support functions that are common to the Services, as discussed previously in this chapter, and it is appropriate that the deputy minister and his staff should take the initiative in this matter.

In the latter connection, the deputy minister has a major role to play in matters of supply. In the report on *Purchasing and Supply*, your Commissioners urged that measures be taken to improve inventory control and inter-Service co-operation in the storing and distribution of equipment and supplies. Greater standardization of requirements and rationalization of supply on a tri-Service basis will yield significant economies. The initiative can best be provided within the deputy minister's organization, building on the experience already developed there under the assistant deputy minister (requirements) and in the development of a common nomenclature for defence supplies.

Finally, the proposals put forward by your Commissioners in the first volume of reports, for the strengthening of departmental authority over and responsibility for management, will add significantly to the task of the minister and accentuate the need for improved staff support within the department.

We therefore recommend that: The Deputy Minister of National Defence be given greater responsibility for keeping under review the organization and administrative methods of the Canadian defence establishment, and assisting and advising the Minister in the discharge of his responsibility for the control and management of the Armed Forces.

CIVILIAN AND MILITARY ROLES

Thus far in this report the deputy minister's organization and the Service staffs have been treated as forming separate civilian and military aspects of the Department. It does not follow, however, that civilian and military personnel can or should be sharply segregated on this basis. Of the 50,000 civilians in the Department, the vast majority are employed under the direction of the Armed Forces as tradesmen or in junior administrative positions. Considerations governing the employment of civilians in non-combatant Service activities are discussed in the next chapter, but several aspects of the existing organization require notice in the present context.

First, in supporting and non-combatant functions extensively manned by civilians, the senior positions are filled almost exclusively by Service officers. The effectiveness of these activities suffers as a result of the early retirement of officers and from the process of frequent rotation of officers through various branches of the Service as part of the pattern of training and promotion. These factors tend to limit the opportunities for specialization and contribute to a lack of continuity in management, while failing to provide the career incentives that would retain ambitious and competent junior civilians in the Department. Without questioning the necessity for military command of non-combatant operations at the highest levels, your Commissioners believe that the career opportunities for civilians in the senior management of supporting activities should be enlarged.

Second, few civilians are to be found in the higher administrative echelons of the Armed Forces. Experience elsewhere has shown that many senior administrative tasks of the Services can be efficiently performed by civilians, even in such fundamentally military staff functions as those dealing with plans and operations. Where Service officers and civilians work together at the senior levels of administration, their different backgrounds and experience contribute to better performance and, because the civilians are not subject to the Services processes of frequent rotational posting and retirement on pension at a relatively early age, the arrangement permits continuity otherwise difficult to achieve. This successful practice has not been followed in Canada, nor have any measures been devised to retain the administrative skills of senior Service officers who are now retired compulsorily in their early fifties.

Greater employment of civilian officers in the administration of the Services would also be of potential advantage to the civilian side of the Department—the deputy minister's organization. Promising civilian officers could, by means of postings to military staff duties, be given a greater familiarity with Service matters which would equip them better for senior positions

under the deputy minister, and would reduce the tendency—to which civilians are all too prone—to regard military affairs as professional mysteries comprehensible only to the military mind. The importance of this consideration is enhanced by the proposed enlargement of the role of the deputy minister's organization.

It is important that civilians employed in senior administrative posts in the Services should not be looked upon as having any duty to control or check Service activities. Their sole function should be to assist the Services and provide continuity in administering programmes, bringing an additional viewpoint and sometimes special skills to bear, and serving as partners and co-workers with the Service officers. One object of the policy is, in fact, to prevent the segregation of civilian and military elements into two separate organizations between which antagonisms can too easily develop.

The corollary of this is that Service officers have a role to play in the civilian establishment, from which they are now largely excluded. In recent years there has been a growing emphasis on means of broadening the outlook of military personnel in order that they may better understand their function in its wider context—both within the general framework of government and as an integral part of, rather than as an adjunct to, the community at large. Much indoctrination and training has been directed to this end, of which the outstanding example is the National Defence College. The results have been encouraging, but the most effective means of achieving this object may lie in so organizing the defence establishment that military personnel—especially senior and intermediate officers—are given experience in positions that bring them into closer touch with the civilian processes of government. The benefits accruing to the organization of the deputy minister from the infusion of capable Service officers would be no less great, particularly in view of the enlarged functions proposed for that organization.

We therefore recommend that:

- 1 Career opportunities be improved for civilian technical and administrative personnel employed in the Armed Forces.
- 2 There be a greater interchange of Service and civilian officers, especially of intermediate and senior rank, between the headquarters staffs of the Armed Forces and the organization of the Deputy Minister.

3

MANPOWER POLICIES AND PRACTICES

PRESENT TRENDS

Expenditures for military personnel have increased steadily in recent years. In 1951, these costs were \$184.3 million or 23.6 per cent of the defence dollar; eleven years later the corresponding figures were \$593.6 million and 36.8 per cent. The operating and maintenance costs of the Services kept pace with this growth, and by 1962 totalled \$616.4 million, or 38.2 per cent of the defence dollar. Included in the latter figures are additional personnel costs of \$265 million, of which approximately \$200 million represents the remuneration of the civilians employed by the Armed Forces. Appendix 4 is a summary of estimated military and civilian personnel costs by classes. This appendix discloses that the annual remuneration of the average serviceman approximates \$5,250 (plus the value of medical and dental care), while the average cost of civilians employed by the Service is approximately \$4,000. Since the civilian employees mainly occupy relatively junior positions, a more appropriate comparison is made by omitting the remuneration of commissioned officers from the Service averages, as shown in Table 3.

Table 3—AVERAGE ANNUAL REMUNERATION 1961-62

	<i>"Other Ranks"*</i>	<i>Civilians</i>
Navy	\$ 4,517	\$ 4,283
Army	\$ 4,597	\$ 3,981
Air Force	\$ 5,055	\$ 3,828
All Services	\$ 4,772	\$ 4,014

* All ranks other than commissioned officers.

The comparison shown in Table 3 is subject to certain fundamental differences in the respective terms of employment of uniformed and civilian personnel. Civilians are available for from ten to eighteen per cent more productive activity than servicemen, due to military demands on the time of the latter, such as attendance at parades and posting for training courses. On the other hand, a serviceman may be ordered to work during weekends and at holiday periods without supplementary pay or compensatory benefit, and can be transferred from one location to another at any time without negotiation. It has not been practicable to develop a monetary measure of these differences but observations in Canada confirm the experience in the United Kingdom that, in general, it is less costly to employ a civilian than a serviceman. Part of the difference must, of course, be attributed to the obligation of the serviceman, which the civilian does not share, to risk his life on active service.

DETERMINATION OF SERVICE AND CIVILIAN STRENGTHS

In Canada, efforts that have been made from time to time to realize savings by using civilians in place of Service personnel have been effectively frustrated by the lack of procedural co-ordination. The fault is that the respective ceilings for military and civilian personnel are set, without regard one for the other, by different methods and by separate authorities.

The Cabinet periodically determines the numerical strength of the Armed Forces in round numbers. These approved Service strengths are subject to infrequent adjustment, as required by changes in international obligations or in the budgetary position of Canada. Within each Service, the Chief of Staff allocates military manpower as he sees fit; his prime concern is the prospective need in an emergency, and the potential advantages of substituting civilians for servicemen have low priority in such decisions. It is only reasonable to assume that the tendency, when in doubt, is to use uniformed personnel, for military commanders are naturally reluctant to accept the risk of any impairment of military effectiveness on grounds of economy.

Civilian employees of the Department of National Defence, other than those of the Defence Research Board, are generally subject to the provisions of the *Civil Service Act*. As in other departments, an annual establishment review is conducted by representatives of the Civil Service Commission and the Treasury Board. In this review notice is taken of the military component of the work forces required, although the central agencies have no jurisdiction over either the numbers of servicemen or the tasks to which they are assigned. Since each Chief of Staff has absolute control over his own Service, the role of the central agencies tends to be advisory with regard to military-civilian

establishments. Inevitably, there is a conflict of standards. A military commander may assign a given number of servicemen to a particular function, not because of their aptitude for the work but because he may need them some day for war purposes and, in the interval, must find work for them. The Civil Service Commission, on the other hand, is vitally concerned with the suitability of personnel and the equitable relationship of the pay scale to the task to be performed.

Against this background it is not difficult to perceive why only limited manpower economies have been achieved. If, for example, as a result of a competent study, it were found that 5,000 positions now filled by servicemen could be filled by civilians at less cost, the hiring of the civilians, without a coincident adjustment in the Service ceiling, would simply mean that new jobs would be found for the 5,000 servicemen displaced, and that the defence budget would be increased by the cost of the additional civilians. Thus the existing rules lead to the curious result that true economy can be effected only by deliberately displacing the lower-cost civilian with the higher-cost serviceman, because when this is done the civilian position is eliminated. A steady increase in the ratio of uniformed to civilian personnel over the past eight years in all three Services, which is shown in Appendix 5, owes something to these circumstances.

SERVICE PERSONNEL IN SUPPORT ACTIVITIES

About 60,000 military personnel, all of whom have been recruited into the Services as physically fit for the active defence of Canada, are engaged in supporting or non-combatant activities. Although the Services have gone a considerable distance in civilianizing some support activities, the pattern is by no means consistent. For example, the ratio of civilian to military personnel shows wide variations in five corps of the Canadian army, as shown in Table 4.

Table 4—PERCENTAGE OF CIVILIANS TO TOTAL PERSONNEL

Royal Canadian Engineers	82%
Royal Canadian Corps of Signals	28
Royal Canadian Army Service Corps	20
Royal Canadian Ordnance Corps	62
Royal Canadian Electrical and Mechanical Engineers	55

It is in groups such as these that the possibilities for civilian employment are greatest, but current practices in dealing with employment ceilings create a notable lack of flexibility in adjusting Service work forces to changing work loads, which are susceptible to measurement, whereas the civilian work forces

are more readily adjustable. For these reasons, it is open to question whether it is in the national interest to employ such a large number of uniformed personnel in tasks that could be performed by civilians at less cost. An escape from the rigidities of Service manpower controls promises substantial economies through the adjustment of work forces to actual need in support activities.

Appendix 5 also discloses remarkable differences in the proportionate employment of civilians by each of the three Services. If the proportion achieved by the Navy could be matched by the other two Services, over 16,000 servicemen would be replaced by civilians. The effect of a change of this nature, assuming that the Armed Forces were reduced from 125,000 to 109,000, would be to leave approximately 44,000 Service personnel, or only 40 per cent of the total, in support functions. The direct savings in salaries and benefits might be in the order of \$20 million a year. Additional savings resulting from reductions in work forces following such an adjustment are conjectural, but would undoubtedly be substantial.

In May, 1961, the Minister of National Defence set up a Departmental committee of high-ranking Service officers, under the chairmanship of the Associate Deputy Minister, to make a "thorough review of the organization and employment of military manpower in the non-combatant field". About thirty sub-committees and working groups have been formed, and are currently engaged on the study full time. This is the first broad enquiry of this nature that has been attempted, and there is plenty of evidence to suggest that it is overdue. The Committee is making a painstaking approach to the problem, but your Commissioners have certain misgivings about the final outcome. In particular, the Committee is composed entirely of Departmental personnel and the enquiry has been subjected to an arbitrary limitation to positions held up to and including the rank of Major or the equivalent in the other Services, thus excluding the greater part of the senior administrative area.

The Committee's enquiries indicate that, of 11,143 positions in National Defence Headquarters, both civilian and military, only an additional 248 could be filled by civilians. A further 300 positions, mainly filled by corporals and privates or the equivalent, are the subject of continuing study. These findings raise a number of pertinent questions:

- Why does the Royal Canadian Air Force require 58 per cent of its headquarters establishment in uniform and the Army 52 per cent, while the Navy gets along with 20 per cent?
- What considerations determine the need for military personnel acting as

executive secretaries for 350 committees at headquarters? Currently 198 are civilians and 152 servicemen.

- What is the rationale for the decision that the staff of the Military Historian should consist of nine civilians and 23 servicemen?
- In the Royal Canadian Air Force, is it consistent to fill all the 41 positions in the Directorate of Accounting with servicemen, while in the Directorate of Statistics 44 of the 65 positions are held by civilians?
- What circumstances dictate that 54 per cent of the Air Materiel Command should be in uniform, when the Navy can manage the similar function with approximately 5 per cent?

Your Commissioners are of the opinion that the enquiries of this Committee should be extended to all ranks of the Services, and that the membership of the Committee should be supplemented by senior civil servants from other departments and advisers from outside the public service.

EARLY RETIREMENT OF OFFICERS

The need for youth and physical fitness in combat underlies the current policy of retiring Service officers at ages much earlier than would be normal in other occupations. Additional objectives of this policy are first, to render service in the Armed Forces more attractive to young people—a need illustrated by the high costs of recruiting junior officers, which is discussed in the report on *Education Services*; and second, to keep the services vital and provide incentive to younger men by eliminating road-blocks to the senior positions. Nevertheless, this is a costly practice in terms of both the wastage of experience gained at public expense and the substantially increased costs of providing pensions. Whatever justification there may be for employing only relatively young officers in combatant formations, the question may be asked whether the same considerations are necessarily applicable to officers performing non-combatant duties—a very significant percentage of the total.

Retirement pensions and their actual value at compulsory retirement ages are shown in Table 5 for various ranks in the Army; equivalent ranks in the other Services receive the same treatment.

The actual values shown below are present values in the usual actuarial sense. In other words, for large numbers of pensioners, if these amounts were placed in a fund earning interest at 4 per cent per annum, they should be sufficient to meet all payments as they become due, including benefits to dependents.

Table 5—COMPULSORY RETIREMENT AGES, PENSION AND PENSION VALUES FOR ARMY OFFICERS

<i>Rank</i>	<i>Retirement Age</i>	<i>Annual Pension</i>	<i>Actual Value of pension annuity at date of retirement</i>	<i>Actual Value of same pension if retirement took place at 65</i>
Lieutenant	45	\$ 3,747	\$ 50,000	\$ 23,000
Captain	47	3,601	64,000	30,000
Major	49	4,643	81,000	40,000
Lieutenant-Colonel	51	6,001	101,000	53,000
Colonel	53	7,438	121,000	67,000
Brigadier	55	9,732	153,000	91,000
Major-General	55	10,937	171,000	102,000
Lieutenant-General	55	12,096	190,000	113,000

Some countries seek to mitigate similar costs by inserting civilians at all levels in the supporting services; others differentiate between combatant and non-combatant officers in fixing retiring ages. To salvage the accumulated experience and ability of officers retired at early ages, some countries create civilian posts in defence departments, with duties and salaries structures specifically designed for those in receipt of military pensions. In such instances, engagement in civilian employment with the government does not, as in Canada, bring about a suspension of military pensions. Canadian policy in these matters needs careful consideration to prevent the avoidable losses inherent in present practices.

- We therefore recommend that:*
- 1 A comprehensive and independent review be made of the military and civilian manpower needs of the Armed Forces.
 - 2 In making future adjustments of manpower ceilings for either Service or civilian defence personnel, the requirements in both groups be reviewed simultaneously.
 - 3 Consideration be given to the compulsory retirement policy of the Services and the possibility of creating employment opportunities within the public service for Service personnel retiring at early ages.

APPENDICES 1 TO 5

Appendix 1—MANPOWER OF THE ARMED FORCES

For Selected Fiscal Years 1950 to 1962
(Thousands)

Year	Regular Forces				Reserve Forces ¹				Grand Totals ²
	Navy	Army	Air Force	Totals ²	Navy	Army	Air Force	Totals ²	
1949-50									
Strength.....	9.3	20.7	17.3	47.2	3.7	43.0	2.4	49.1	96.3
1951-52									
Enrolments.....	3.8	22.4	12.7	38.9	1.7	16.3	3.1	21.2	60.1
Net Increase.....	2.4	14.3	10.3	27.0	1.3	.5	1.6	3.4	30.3
Strength March 31....	13.5	49.3	32.6	95.4	5.1	46.9	4.8	56.8	152.2
1955-56									
Enrolments.....	2.9	6.1	7.6	16.6	2.1	18.6	2.3	22.9	39.5
Net Increase.....	-.1	-1.8	.5	-1.4	.3	-2.1	.1	-1.6	-3.0
Strength March 31....	19.1	47.6	50.0	116.7	5.8	44.0	5.5	55.3	172.0
1956-57									
Enrolments.....	2.7	6.9	7.7	17.3	1.9	18.1	2.0	22.0	39.3
Net Increase.....	—	-.3	.7	.4	-.2	-3.1	-.3	-3.6	-3.2
Strength March 31....	19.1	47.3	50.7	117.1	5.6	40.8	5.2	51.6	168.7
1957-58									
Enrolments.....	3.3	7.6	7.7	18.6	1.3	20.7	1.9	23.9	42.5
Net Increase.....	.8	.2	1.0	1.9	-1.0	.5	-.5	-1.0	.9
Strength March 31....	19.9	47.5	51.7	119.0	4.5	41.3	4.8	50.6	169.7
1958-59									
Enrolments.....	3.2	5.9	5.3	14.4	1.0	19.3	1.5	21.8	36.2
Net Increase.....	.6	.8	-.1	1.4	-1.2	-.3	-.7	-2.2	-.9
Strength March 31....	20.5	48.3	51.6	120.4	3.3	41.0	4.1	48.4	168.8
1959-60									
Enrolments.....	3.1	4.4	4.9	12.4	1.3	18.7	1.4	21.3	33.7
Net Increase.....	.2	-1.1	.1	-.8	—	-1.0	-.3	-1.3	-2.1
Strength March 31....	20.7	47.2	51.7	119.6	3.3	40.1	3.8	47.1	166.7
1960-61									
Enrolments.....	2.6	6.2	4.3	13.1	1.6	20.5	1.2	23.3	36.4
Net Increase.....	—	.9	-.4	.5	.4	3.2	-.7	2.9	3.4
Strength March 31....	20.7	48.1	51.3	120.1	3.7	43.2	3.1	50.0	170.1
1961-62									
Enrolments.....	3.2	8.9	5.8	17.9	1.6	97.4 ³	.8	99.8	117.7
Net Increase.....	.8	3.8	1.8	6.4	—	39.4	-.7	38.7	45.1
Strength March 31....	21.5	51.9	53.1	126.5	3.7	82.6	2.4	88.7	215.2

¹Reserve figures do not include University Naval Training Detachments, Canadian Officers Training Corps or Reserve University Squadrons.

²Do not necessarily add due to rounding of figures.

³Includes personnel enrolled for Special Military Training Programme for Survival.

Appendix 2—BUDGETARY EXPENDITURES BY SERVICE

For Fiscal Years Ended March 31, 1951 to 1962
(\$ Million)

<i>Item</i>	<i>1951</i>	<i>1952</i>	<i>1953</i>	<i>1954</i>	<i>1955</i>	<i>1956</i>	<i>1957</i>	<i>1958</i>	<i>1959</i>	<i>1960</i>	<i>1961^a</i>	<i>1962^b</i>
Air Force.....	230.6	650.5	912.5	915.0	814.7	798.1	863.1	813.7	797.4	743.3	752.6	778.5
Army.....	231.7	473.1	503.4	436.4	454.4	461.4	459.5	424.7	432.9	400.8	400.1	420.1
Navy.....	99.8	182.4	260.3	289.0	304.2	340.8	326.7	295.0	273.0	255.8	248.6	280.0
Defence Research Board.....	23.4	35.4	43.0	40.8	49.9	64.6	69.3	78.7	74.4	39.2	44.2	46.1
Mutual Aid and NATO Infra-structure.....	195.4	129.9	246.4	300.2	260.0	175.0	133.6	118.5	70.7	18.4	15.5	16.0
Other.....	20.9	41.8	48.7	56.8	57.0	59.7	66.2	70.1	70.8	72.3	61.0	80.9
<i>Deduct:</i>												
NATO Aircrew Training Charged to Mutual Aid.....	—	48.6	104.6	71.3	52.9	51.1	47.8	26.4	6.8	—	—	—
Transfers of Equipment Charged to Mutual Aid.....	—	—	40.0	114.6	127.5	38.2	63.7	78.4	50.6	—	—	—
Expenditures from Special Accounts.....	19.9	49.0	-12.7	46.4	93.8	60.2	47.5	27.4	237.1	14.9	3.0	6.0
TOTAL BUDGETARY EXPENDITURES.....	781.9	1,415.5	1,882.4	1,805.9	1,666.0	1,750.1	1,759.4	1,668.5	1,424.7	1,514.9	1,519.0	1,615.6
^a Preliminary												
^b Estimates												

Appendix 3—DISTRIBUTION OF NATIONAL DEFENCE DOLLAR

For Fiscal Years Ended March 31, 1951 to 1962
(Per Cent)

Item	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961 ^a	1962 ^b
Equipment.....	18.5	34.3	38.1	42.4	39.0	32.5	26.1	24.7	29.9	19.3	18.9	18.9
Construction.....	11.0	12.2	14.2	9.2	7.4	7.8	8.0	5.5	5.3	5.8	5.1	5.5
Mid-Canada Line.....	—	—	—	—	.1	2.6	7.4	2.0	.2	—	—	—
Military Personnel Costs.....	23.6	24.5	21.6	22.2	26.7	26.5	38.4	32.7	38.9	36.0	37.1	36.8
Operation and Maintenance Costs.....	24.5	26.8	21.8	24.3	29.2	30.0	32.0	36.1	41.5	38.7	38.1	38.2
Infrastructure and NATO.....	—	.3	.7	.7	.7	.6	.8	.6	.9	1.2	1.0	1.0
Net Charges to Special Accounts	22.4	1.9	3.6	1.2	-3.1	—	-2.7	-1.6	-16.7	-1.0	-2	-4
TOTAL.....	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

^aPreliminary ^bEstimates

Appendix 4—SUMMARY OF ESTIMATED ANNUAL PER CAPITA PERSONNEL COSTS FOR 1961-62
EXCLUDING MEDICAL AND DENTAL CARE COSTS FOR SERVICE PERSONNEL

	<i>Direct Benefits</i>	<i>Government Contribution to Pension Fund</i>	<i>Sub-Total</i>	<i>Travel and Transportation</i>	<i>Other¹</i>	<i>Grand Total</i>
	\$	\$	\$	\$	\$	\$
OFFICERS						
RCN.....	6,912	700	7,612	208	129	7,949
Army.....	6,805	689	7,494	235	108	7,837
RCAF.....	6,469	655	7,124	232	306	7,662
<i>Weighted Average—All Services.....</i>	<i>6,647</i>	<i>673</i>	<i>7,320</i>	<i>229</i>	<i>196</i>	<i>7,745</i>
OTHER RANKS						
RCN.....	3,792	388	4,180	208	129	4,517
Army.....	3,860	394	4,254	235	108	4,597
RCAF.....	4,099	418	4,517	232	306	5,055
<i>Weighted Average—All Services.....</i>	<i>3,944</i>	<i>403</i>	<i>4,347</i>	<i>229</i>	<i>196</i>	<i>4,772</i>
ALL RANKS						
RCN.....	4,247	433	4,680	208	129	5,017
Army.....	4,235	432	4,667	235	108	5,010
RCAF.....	4,566	465	5,031	232	306	5,569
<i>Weighted Average—All Services.....</i>	<i>4,378</i>	<i>446</i>	<i>4,824</i>	<i>229</i>	<i>196</i>	<i>5,249</i>
CIVILIANS						
RCN.....	4,007	240	4,247	32	4	4,283
Army.....	3,633	217	3,850	63	68	3,981
RCAF.....	3,533	211	3,744	62	22	3,828
<i>Weighted Average—All Services.....</i>	<i>3,702</i>	<i>222</i>	<i>3,924</i>	<i>54</i>	<i>36</i>	<i>4,014</i>

¹Other allowances include: Risk Allowance, Aircrew Allowance, Clearance Diving Allowance, Submarine Allowance, Isolation Allowance and similar allowances applicable under specific circumstances.

Appendix 5—RATIOS OF SERVICE PERSONNEL TO CIVILIAN STAFFS

December 31, 1955 to March 31, 1962

<i>Date</i>	<i>Uniformed Personnel</i>	<i>Civilians Excluding Casual Labour</i>	<i>Ratios Uniformed to Civilian Personnel</i>
ROYAL CANADIAN NAVY			
31 December, 1955.....	19,223	11,258	1.7074 to 1
31 December, 1956.....	19,005	11,550	1.6454 to 1
31 December, 1957.....	19,815	11,669	1.6980 to 1
31 December, 1958.....	20,252	11,508	1.7598 to 1
31 December, 1959.....	20,561	11,477	1.7914 to 1
31 December, 1960.....	20,539	11,173	1.8382 to 1
31 December, 1961.....	21,114	11,104	1.9014 to 1
31 March, 1962.....	21,547	11,067	1.9470 to 1
CANADIAN ARMY			
31 December, 1955.....	47,162	18,912	2.4938 to 1
31 December, 1956.....	47,632	18,618	2.5583 to 1
31 December, 1957.....	47,938	18,937	2.5314 to 1
31 December, 1958.....	48,682	18,675	2.6067 to 1
31 December, 1959.....	47,830	17,613	2.7156 to 1
31 December, 1960.....	47,574	16,940	2.8083 to 1
31 December, 1961.....	49,923	16,867	2.9598 to 1
31 March, 1962.....	55,951	16,137	3.2197 to 1
ROYAL CANADIAN AIR FORCE			
31 December, 1955.....	50,330	13,867	3.6294 to 1
31 December, 1956.....	50,540	14,220	3.5541 to 1
31 December, 1957.....	51,661	14,544	3.5520 to 1
31 December, 1958.....	51,914	14,190	3.6585 to 1
31 December, 1959.....	51,544	13,342	3.8632 to 1
31 December, 1960.....	51,193	13,438	3.8095 to 1
31 December, 1961.....	52,731	13,239	3.9830 to 1
31 March, 1962.....	53,124	13,456	3.9480 to 1

21 DEPARTMENT OF EXTERNAL AFFAIRS

SPECIAL AREAS OF ADMINISTRATION

REPORT 21: DEPARTMENT OF
EXTERNAL AFFAIRS

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Your Commissioners, in acknowledging the assistance and advice received, dissociate all those named above from any of the findings and conclusions contained in this report; for these, your Commissioners assume full responsibility.

1

INTRODUCTION

A foreign service has problems of organization and management which distinguish it from most other departments of government. In some respects these problems liken it to the Armed Forces: its operations tend to be multi-centred and its missions dispersed in areas remote from headquarters; its officers are subject to rotational postings and are somewhat removed from direct contact with the public; it operates a widespread communications network which handles a constant stream of information, much of it highly confidential. Furthermore, to say that its role is to "represent abroad the interests of the nation" is comparable—in vagueness and generality—to proclaim the task of the Armed Services as the "defence of the nation".

To fulfil its assignments, a foreign service must engage in extensive research, advisory and co-ordinative activities that entail a mixture of the academic, the political and the administrative, using as raw material the information gathered in various forms by its missions around the world. All these elements, coupled with the high policy content of many of its concerns, give a foreign service a special place in government.

These distinctive features, however, do not relieve the foreign service of certain responsibilities akin to those of any other of the civil departments; the need to recruit, train and manage its staff; the need to budget and allocate its financial resources; the need to develop appropriate systems and procedures to cope with its massive paperwork problems; and the necessity of maintaining a variety of supporting services, which in its own case include supplying and housing its missions abroad and providing channels of communication with its far-flung outposts.

In Canada, the *Department of External Affairs Act* declares that the Secretary of State for External Affairs, as head of the Department, has the conduct of all official communications between the Government of Canada and the government of any other country in connection with the external affairs of Canada. His intercourse, either directly or through his officers, is carried on either through the representatives of other governments in Canada or through the representatives of Canada abroad. The Department negotiates, protects Canadians and Canadian interests abroad, promotes good relations with other countries and fosters Canadian trade in co-operation with other departments of government. All of these are traditional roles of a foreign secretary but, today, notice must also be taken of a comparatively recent and significant obligation placed on the Secretary of State for External Affairs: he is now continuously concerned with the activities of the United Nations and other international organizations. It follows that in a very special way the organization and activities of this Department are of concern to all departments of government.

The Department of External Affairs originated in 1909 as a special division of the Department of the Secretary of State. By 1912, when placed under the Prime Minister, it had two officers and a staff of fifteen in Ottawa, and the annual cost of operations was less than \$25,000. The first development of the service outside Canada took place in 1921 when the office of the High Commissioner in London was made part of the Department. By World War II additional missions had been established in Geneva, Washington, Paris, Tokyo, Brussels and The Hague.

Canada's emergence during and after World War II as a "middle power" is clearly reflected in the rapid growth of the Department of External Affairs after 1940, as shown by the following comparisons:

Table 1—DEPARTMENT OF EXTERNAL AFFAIRS OPERATING COSTS, EMPLOYMENT AND FOREIGN MISSIONS IN 1940 AND 1960

	1940	1960
Operating Costs	\$ 750,000	\$20,500,000
Personnel:		
Officers	44	414
Other staff	328	1,462
Total	372	1,876
Number of Missions Abroad	7	65

Growing international commitments have affected not only the Department of External Affairs but also other departments which now maintain offices

abroad. This proliferation of offices and agencies has created new problems of co-ordination and control for the headquarters staff of External Affairs and of the other departments concerned. Two other developments have also served to broaden the responsibilities of the Department of External Affairs. First, Canada's role as a partner in NATO and in the defence of North America has imposed the need for close collaboration between the Departments of External Affairs and National Defence. Second, the scientific and technological explosion, following the second world war, has introduced a new order of international commitments involving such matters as nuclear energy and outer space. The country's scientific policy and programmes have to be harmonized with international obligations, a process in which the Department of External Affairs plays a role.

Faced by internal pressures of rapid growth and the external pressures of Canada's new commitments, the Department has been hard put to perform its task effectively. An increasing degree of specialization has become necessary to meet the complex responsibilities of the day, with the skills of economists, scientists, international lawyers and other specialists more and more in demand. The growth and broadening of scope has likewise placed new pressures on the whole range of administrative and supporting services. The requirements for communications, for the orderly handling of records and documents, for the housing and supply of missions, and for the maintenance of proper facilities for economic and historical research, have all assumed new dimensions. New forms of organization, new techniques and special skills are now required and continued reliance on practices and procedures appropriate only to a small scale organization significantly limit the effectiveness of performance.

In short, the increasing tempo of international affairs has placed new strains on an organization that was originally geared to a more leisurely pace, with administration conducted on informal lines. The growth in staff and of commitments abroad has posed new challenges for senior management. The response of the Department to these converging pressures constitutes the main theme of this report.

2

THE CONDUCT OF FOREIGN RELATIONS

STAFFING THE FOREIGN SERVICE

The prime concern of the Department of External Affairs lies in the development of policy and the conduct of Canada's day-to-day dealings with other governments. The principal duties of the Department are to serve:

- As the chief instrument for advising the government on matters relating to the conduct of Canada's external relations.
- As an official channel of communication between the Canadian government and the governments of countries with which diplomatic relations are maintained.

These tasks call for the employment of highly skilled officers in an Ottawa headquarters and for the maintenance of a system of missions, located in centres of importance throughout the world, and manned by competent and responsible officers. Upon this structure are laid several secondary responsibilities of considerable importance, including protection of Canadian interests and assistance to Canadian citizens in foreign lands; representation of Canada abroad, and projection of the country's image; and the co-ordination of the external activities of other departments and agencies. The substantive work of the Department includes all these tasks and is entrusted to a corps of foreign service officers constantly shifting between Ottawa and the various missions on the basis of a planned rotation. In support of these activities an administrative and service organization of considerable size and complexity is maintained, the adequacy and efficiency of which is considered in the succeeding chapter.

The Rotation of Officers

In common with other Foreign Offices, the Department of External Affairs has nurtured a concept of the foreign service officer as a man of broad competence and experience, capable of adapting rapidly to new assignments. The rotation of officers through a wide variety of tasks and offices clearly follows from this concept of the so-called "generalist". This approach to manpower development and utilization, which stresses the "generalist", may be rationalized on the score that all hands have to be equipped to do everything and have, in fact, been often called upon to take on a great range of assignments.

The system, however, is now being undermined from two directions, as a result of the growth in size of the Department and its necessary participation in a number of specialized fields. First, the very substantial increase in staff and in the number of missions abroad, over the past two decades, has made heavy demands on the housekeeping arrangements within the Department. Personnel management, paperwork and systems management, the handling of large real property operations and an impressive communications network—to mention only a few major items—are tasks which cannot be readily performed as a part of the training of a foreign service officer; they require persons with special skills and sufficient permanency on the job to provide a strong supporting base for the primary functions of the Department. Second, involvement in certain areas of the world now calls for special linguistic skills or esoteric knowledge of some remote country; complex international negotiations require the presence of specialists in particular disciplines or fields of professional knowledge. In such cases the "generalist" concept, when coupled with rotation, tends at worst to break down, and at the very least to be too thin for the needs of effective policy-making and administration.

Nevertheless, experience with the generalist-rotational system, both in Canada and in other countries, appears to justify its continuation. There is general agreement that a foreign service, to be effective, should rely to a large extent on men whose skills are represented by those qualities of intelligence, perception and character which distinguish persons of general ability. To take full advantage of these skills, and to add to them the benefits of a broadly developed interest and experience, rotational assignments are agreed to be essential. On the other hand, carried to extremes this system can weaken and virtually destroy efficiency in those supporting services requiring special skills and continuity of management.

A rational approach to the management of the rotation of personnel involves only simple arithmetic. There is at any time a relationship between

the number of positions at headquarters which can properly be filled by foreign service officers and the number of such officers required in the posts abroad. If these happen to be equal, the foreign service officer class may spend half its time in Ottawa and half abroad. If the number at foreign posts is double the number in Ottawa, the foreign service officer must spend two-thirds of his time abroad. The ignoring of this equation and any striving to achieve an equal division between home and foreign service can lead to a flooding of the headquarters with officers trained for diplomacy assigned, on returning home, to administrative and service tasks for which they may be ill equipped. Some of the present weaknesses in the supporting services trace their origin to this expedient.

Recruiting and Training

The selection of foreign service officers is based on written tests and oral board examinations. The evidence suggests that the average level of persons entering the Department in recent years, while still high, is no longer able to sustain a diplomatic service with the intellectual standards that once characterized the Department. For this there are a variety of reasons, with some beyond the control of the Department. Relatively few advanced students are now entering the foreign service, a consequence being that an increasing proportion of the entrants possess a Canadian university B.A. only. There is virtually no recruiting into the middle or senior ranks of persons with distinguished attainments in academic or other walks of life. Similarly, the inflow from other departments is surprisingly low, despite the fact that the Canadian public service contains many with qualifications and experience which would strengthen External Affairs. Conversely, it is not the practice to second foreign service officers to key departments for experience. One result is that, interdepartmentally, External Affairs personnel frequently display a lack of understanding of other departments and their programmes, particularly where these programmes often involve Canadian interests abroad; and such a lack of understanding by departmental officers is both a weakness in itself and a matter of considerable annoyance to other departments.

Perhaps the most urgent need is to establish sounder procedures throughout the probationary and training period of new officers. The "University of the East Block" with its seventy-five hours of scheduled lectures is not sufficient. A more intensive programme of lectures might be established by treating the probationer as an assistant to a more senior officer during the mornings and leaving the afternoons free for special lecture courses in languages, foreign policy, Canadian government and the like. The second half of the probationary year would find the candidate full-time on departmental duties and pos-

sibly on short-term visits to several missions abroad, and to other departments at home whose affairs have international implications. It should be a condition of permanent appointment that the probationer equip himself with a sound working knowledge of the French and English languages.

Your Commissioners are not disposed to recommend changes that would dismember the present officer corps. However, there are certain dangers in the system which need to be guarded against. Not the least of these is the possibility that the foreign service officer group may develop into a segregated élite. The concept of a separate corps is valid, not because the capabilities of its staff are necessarily greater than those required in other departments of government, but because the proper performance of the representational role abroad calls for a rather different set of qualifications from those demanded of an officer serving in Canada. Direct recruitment into the foreign service officer class appears to be the best means of obtaining the personnel with the required qualifications.

Nevertheless recruitment techniques are far from infallible and there ought to be a readier means of shifting personnel from the corps, without necessarily stigmatizing the officer concerned. By the same token, the boundaries dividing the corps from the administrative and other staff of the Department should not be so impermeable that these personnel should be without access to the foreign service officer group, should they demonstrate an aptitude or the special qualifications required by the corps. A two-way interchange between foreign service officers and the administrative personnel in other parts of the public service would serve to keep the corps from becoming too in-bred, open promising career prospects for other staff, and permit the transfer of those foreign service officers who, for one reason or another, are not suited for representational duties.

In the report *A Plan for Management* reference has been made to the need for developing within departments an environment more congenial to French-speaking Canadians. While this Department has the best record of any in providing an appropriate balance between French and non-French-speaking officers, the essential working language of the Department is English and the culture in which the French-speaking officer is required to work and live is English-speaking. How to develop himself technically and professionally in an unfamiliar English-speaking milieu while yet retaining his French-Canadian roots and contributing to the Department as a representative of the French-speaking culture, remains a vital and serious problem.

Quite apart from the general desirability of having a foreign service that reflects the bicultural character of Canada, there is another reason for stressing proficiency in the use of the French language. For many years French

and English have been the principal languages of diplomacy. As the international community enlarges with the emergence of new states, a large number of them French speaking, and French continues to be the second language in many non-French countries, the use of French as a working language is increasing to the point where bilingualism becomes a practical necessity. It is noted that 256 officers of the Department have a reasonably good command of French but another 172 officers admit incompetence. Clearly, this latter figure is too high.

Remuneration

At March 31, 1962, the Department had an authorized establishment embracing 2,200 positions, of which over 800 related to service in Ottawa and the balance in foreign missions. These positions are classified in accordance with civil service procedure and most, though not all, positions carrying salaries of \$6,000 and upward are occupied by foreign service officers. The range of salaries of this senior group is given in the following table:

Table 2—DISTRIBUTION BY SALARY RANGES OF EXTERNAL AFFAIRS OFFICERS RECEIVING OVER \$6,000

<i>Annual Salary Range</i>	<i>Number of Officers</i>	<i>Posted</i>	
		<i>In Ottawa</i>	<i>Abroad</i>
\$ 6,000—\$ 8,000	205	121	84
8,000— 10,000	80	36	44
10,000— 12,000	53	22	31
12,000— 14,000	31	16	15
14,000— 15,000	42	13	29
\$15,500	18	1	17
16,500	14	5	9
18,000	5	1	4
22,000	1	1
	<u>449</u>	<u>216</u>	<u>233</u>

Employees of the Department serving in Ottawa are entitled to no special allowances, but those serving abroad may qualify for a number of grants and allowances of which the more important are:

- Basic foreign service allowances, graduated by salary and marital status to compensate for the added cost of living abroad.
- Rent allowances, to cover rentals paid to foreign landlords in excess of the amount, determined by formula, which the employee is required to finance.

- Education allowances, which may reach as much as \$1,400 annually for each child.
- Representation allowances, based partly on salary and official position and partly on entertainment costs actually incurred.

Various other allowances are made and the Department maintains a scrutiny of changes in the value of money in foreign countries and makes periodic adjustments in allowances to compensate therefor. Heads of missions are provided with official residences and domestic staff, and some employees in certain missions are provided with living quarters.

HEADQUARTERS ORGANIZATION

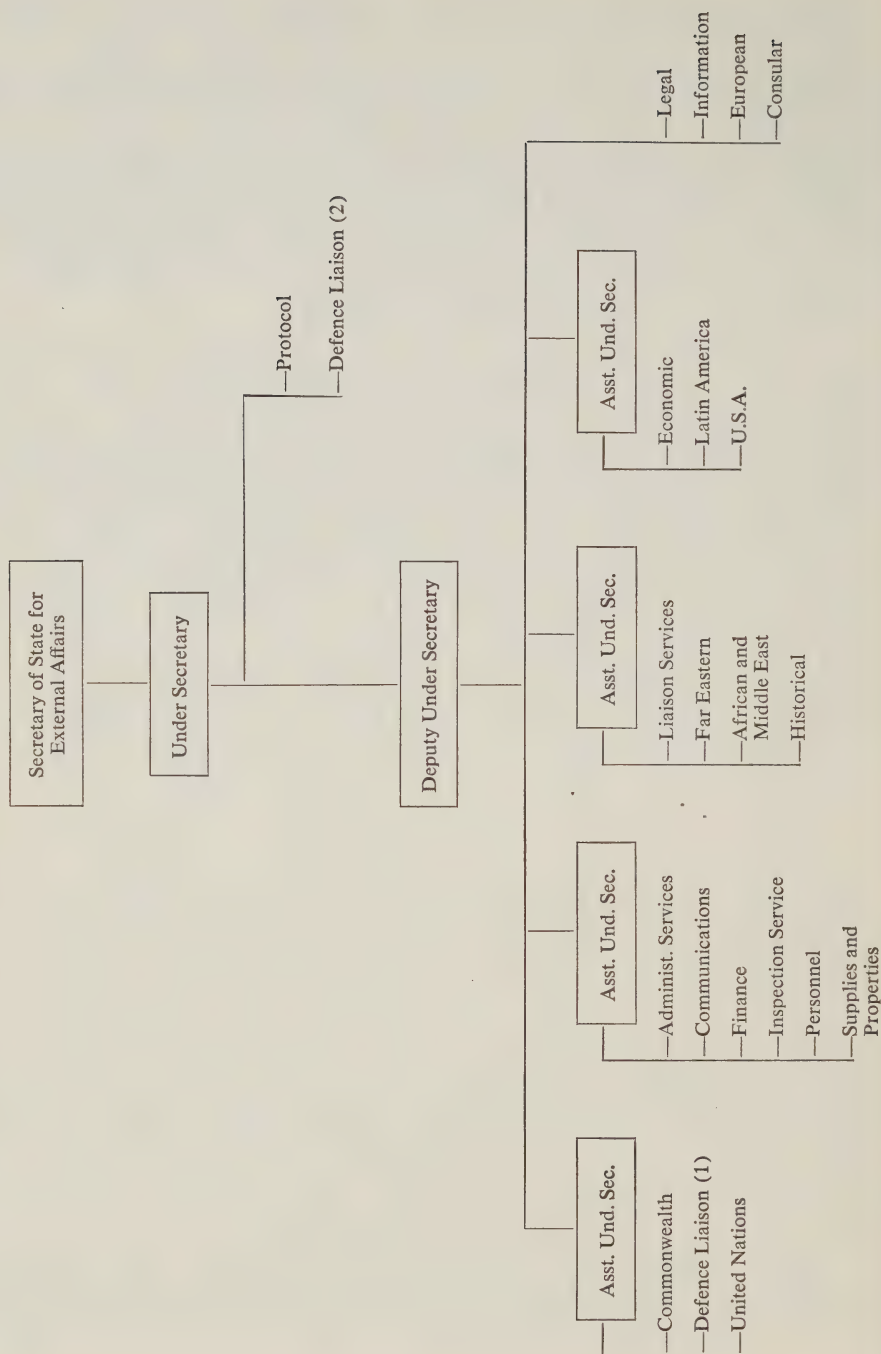
The organization of the headquarters of the Department is depicted graphically in Chart 1. The substantive business of the Department is divided between divisions supervised by a Deputy Under-Secretary and Assistant Under-Secretaries. Within the several political divisions, individual countries or groups of countries are assigned to separate “desks” and the foreign service officers who man these posts are referred to as “desk officers”. This assignment of responsibility for specific areas is accompanied by the designation of the desk officer as the point of contact and channel of communication with the departmental missions in his assigned area. Desk officers, classified as foreign service officers of grades 2, 3, or 4, are paid in a salary range of from \$5,940 to \$9,500 and are subject to rotational posting abroad.

Supervisory Control

Immediately under the Minister (the Secretary of State for External Affairs) responsibility for the management and operation of the Department rests on the Under-Secretary, a Deputy Under-Secretary and four Assistant Under-Secretaries. This small group acts, in effect, as a kind of departmental executive committee, dealing with both policy and administration, but it possesses no formal machinery or staff to assure continuity and to provide follow-up procedures in connection with its supervisory functions. An executive assistant attached to the office of the Under-Secretary could fulfil a needed function in following up decisions taken, keeping the desk officers informed and in other ways fostering effective two-way communication between the top command and the operating level.

The supervisory control suffers from two principal faults. First, the arrangement of the divisions themselves is lacking in consistency. Second, the Deputy Under-Secretary shares with his assistants responsibility for several operating

Chart 1 — DEPARTMENT OF EXTERNAL AFFAIRS PRESENT HEADQUARTERS ORGANIZATION



divisions, thus diverting him from his central concern for over-all co-ordination and policy.

The work of the Department falls into two main categories: political, i.e., advice on policy, co-ordination and consultation; and administrative. The scale and importance of the administrative activities, more fully described in the succeeding chapter, have now grown to the point where responsibility for their conduct needs to be placed on a senior officer. Your Commissioners believe that it would be appropriate to consider appointing a deputy under-secretary to assume charge of each of the main functions, one political, the other administrative.

Apart from the need to strengthen the supervisory effectiveness of the top command, there is need to improve facilities for the development of long-range plans. Currently, divisions of the Department that should be devoting attention to such planning are so involved in day-to-day affairs that they are neglecting a prime function. The solution may be to establish a Policy and Planning Research Committee, comprising the divisional heads and senior management, attendance being determined by the relevance of the subject matter to each division. The Deputy Under-Secretary (Political) would be chairman assisted by an experienced foreign service officer as secretary. Supported by a strengthened Historical and Research Division that could prepare background papers, the proposed Committee should be able effectively to fill an existing gap.

Divisional Management

Each of the geographic and functional divisions is responsible for initiating necessary research, absorbing information coming in from missions within its own orbit of interest, and maintaining communications with them. It is at the divisional level that the full impact of changes in the international situation is felt and where there is an imperative need for flexible adaptation to shifts in the volume of work. The ability of the Department to respond adequately to such variations in the workload is impaired by several aspects of the existing plan of organization. First, attempts to adjust staff to meet changing pressures too often resemble improvisations made on the spur of the moment. A more systematic, planned approach is necessary. Second, the growth of the Department and the distribution of its personnel according to age groups has resulted in almost all its divisions being headed by foreign service officers of grade 6 or 7. This means that the divisional head is an officer who has had one or two postings abroad, has served ten to fifteen years in the department, and will go on to be either the head of a small mission or number two in a larger mission.

The responsibilities of the heads of divisions being what they are, and because the aptitude shown and experience gained have significance in 'slotting' the future administrative hierarchy—at home and abroad—it was a surprise to observe that rarely is an ambassador, on completion of a posting, assigned to such duties. The practice of continuous external postings of those having achieved the status of Head of Mission merits review; both from the viewpoint of making certain that Headquarters is ever strongly staffed and to keep these men abreast with trends in government and Canadian life.

A more logical and functional basis for grouping the divisions is required—one less closely tailored to the personal interest and skills of the particular under-secretary concerned. A possible realignment of the divisions could include:

- The grouping of the two Defence Liaison Divisions with the European Division, the latter divided into new East European and West European Divisions.
- The grouping of the United Nations, Africa and Middle East Divisions.
- The grouping of the Economic and U.S.A. Divisions.
- The grouping of the Latin American, Far Eastern and Commonwealth Divisions.

Such a rearrangement would provide for more supervisory personnel; better co-ordination; more unity of general or functional areas reporting through a particular assistant under-secretary; and sufficient lightening of present burdens on divisional heads to free them for planning and policy functions.

The Desk Officer

The desk officers, of which there are a variable number in each division, man the operational front lines of the Department. Ideally, each should have a detailed knowledge of his field and a grasp of its problems, be they economic, legal, cultural, scientific or political. Here the Department is caught between the increasing need for specialization and the traditional need for sound general political judgment. Today desk officers are often junior persons with limited experience who require close supervision. A sudden crisis in one part of the globe may force a hasty re-shuffling of personnel that brings a completely untried probationer to the desk. The same circumstances may engulf his superior in a flurry of activity that leaves little time for proper supervision.

The real problem of staffing today's foreign service is to ensure competence at every level and particularly to cope with the need for training personnel without paying too high a price in terms of errors, delays, marginally adequate

judgment, and the like. Desk officers should not be rotated so rapidly or be given so many subjects that they are unable to become masters of any. At the same time, staffing should be adequate in numbers, and training so developed that opportunity for specialization is created within the framework of "generalist" development and experience.

There is no easy solution to the problem of preserving the desirable elements of the versatile officer with balanced political judgment and the expert with the specialized knowledge now so clearly essential. The most effective compromise may be to encourage the desk officer who shows talent in a particular function or area to add a degree of specialist interest to his general political experience in the Department. This means developing what may be called the "orbital" approach, which to a large extent already exists in the Economics Division and to some extent in the Middle Eastern, Far Eastern, Latin American and European Divisions.

Where exotic cultures are concerned or where, as in United Nations affairs or disarmament, a high degree of specialization is required, assignment of staff within an orbit of related areas or functions appears desirable. For a period of roughly ten years the postings of a foreign service officer would be confined to a single orbit and he might then be expected to move to a different orbit. This modification of rotation as presently practiced would contribute to greater continuity and stability in the Department, and make more effective use of scarce skills or highly specialized knowledge.

FOREIGN OPERATIONS

The latest annual report of the Department shows Canada maintaining diplomatic relations with sixty-five countries, with missions resident in fifty-two. In addition, eight permanent missions are accredited to international organizations and sixteen consular offices maintained.

The missions vary considerably in size, the Office of the High Commissioner in London being the largest. Total authorized staffs, including locally employed and supporting personnel, range downward from London's top figure of 110; two missions exceed 50; another ten fall between 25 and 50; twenty lie in the 15 to 25 range; and a like number have less than 15 approved positions. Of the consulates, New York is the largest with 26 positions and thus exceeds in size over forty missions. Collectively, the sixteen consulates have 116 approved positions.

The multiplicity of relatively small staff units, although unavoidable, is costly. Since World War II a diplomatic crisis has often developed in unanticipated locales; consequently, each mission has, regardless of the volume of

routine work, a defined minimum establishment which includes two senior officers. Provision must be made for home leave, for illness and to fill gaps when transfers of staff take place. Travel and moving expense cost the department over a million dollars each year. Some relief in the diplomatic area, and a considerable saving in the supporting services, could be found through making more use of the services of local residents and your Commissioners believe that too little effort has been made in this direction.

Heads of Post

Each mission is directed by a head of post, usually designated ambassador or high commissioner. He may be either a career officer of the Department or a person chosen from outside the foreign service. At present, almost all heads of post are career officers. The salaries of those who are not are set by the Governor in Council, the highest currently being \$18,000 per annum. These heads may also qualify for pension (towards which they contribute six per cent of salary) after completing five years' service, attaining the age of sixty-five and retiring from the public service.

It is upon the head of post that the main burden falls for fulfilling the representational role and he is required to follow diplomatic custom in entertainment and in the extension of various services and courtesies of an official nature. For this reason, he is supplied with an official residence, a domestic staff and special allowances. These are designed to meet the cost of carrying out all representational duties. Non-career representative appointments are generally limited to the position of head of post.

Problems of Missions

The duties of a mission abroad include the gathering and reporting of information of many sorts, treating with the host government through its various ministries on all matters of business between it and Canada, the representation of Canada, and a projection of its image, economic, political and cultural, to the people of the country to which it is accredited. In addition it does consular work, issues and renews passports and in some cases performs specific tasks for other departments and agencies of the government.

The larger missions tend to experience a smaller degree of variation in their work loads than do the smaller posts, but by reason of their larger staffs they can more readily respond to emergencies. The effectiveness of the smaller missions, with limited staffs, appears to be prejudiced as a result of certain management practices of the Department. First, the rotational practices provide rather short periods of service at each post, with the result that a portion of the officers are constantly in the process of "settling in",

establishing the necessary contacts and familiarizing themselves with local conditions. Moreover, due to the constantly increasing area of Canada's foreign activities, the replacement of officers transferred to other posts usually involves a delay during which a mission must run short-handed.

Second, there appears to be insufficient senior direction with regard to the nature and scale of activities to be undertaken. Heads of post are in no doubt as to their responsibility for the day-to-day diplomatic business to which they must attend, but many are, in the absence of senior guidance, often uncertain as to what is required of them in the representational area. How actively are they to promote Canada? What initiatives are they to assume in the cultural field? Because these are questions in which little leadership is provided by headquarters, performance tends to vary considerably and depend on the acumen and energy of the head of post. A third cause for concern, particularly in the smaller missions, is the heightened sense of isolation which results from the way in which they are kept informed of current developments at home. Canadian newspapers and periodicals generally travel by surface mail, arriving so long after publication as to have little value as sources of information. Digests of news are circulated daily but in many missions tend to be so brief that only a part of the picture may be conveyed.

Finally, the frequent lack of responsiveness by headquarters tends to frustrate officers posted abroad. All missions are constantly forwarding to Ottawa despatches containing not only current news and information, but reports and appreciations of various subjects, the preparation of which involves long study and research and constitutes evidence of the initiative and ability of the officers concerned. Too often these despatches are not made the basis for further dialogue with the missions regarding their findings, warnings or suggestions. This clearly reflects the inadequacy of the supervisory procedures and staffing of various divisions in Ottawa. Periodic visits by senior officers and consultations by heads of post in Ottawa are not satisfactory substitutes for a fully responsive headquarters organization.

Personnel Problems

Because a revision of allowances has only recently been put into effect, there has been insufficient experience with the new schedules of rates to justify comment. However, it is noted that all allowances, other than language training and certain medical rights, cease when an officer is posted back to Ottawa. Because your Commissioners are particularly concerned with respect to the state of headquarters' administration, it is noted that some foreign services seek to cushion the sharp drop in living standards on home-coming by a home

allowance which lasts from several months to a year; indeed, some foreign services have a system of permanent home allowances.

In considering the allowance problem generally, there is some doubt as to the practicability of the reporting methods required under the revised allowance system. At the same time, it has to be borne in mind that the day of opulent entertainment and living standards as part of diplomacy is, for all practical purposes, at an end. Since most of the work of a mission has to do with local civil servants who are the opposite numbers of those in the mission itself, allowances should not be permitted to get out of line. As long as they suffice to make private means unnecessary as a condition of serving one's country abroad, the proper balance has been struck.

The provision for leave after the completion of a posting raises several problems. Apart from the frequency and duration of the leave, there is the question of the use to which leave should be put. The extent to which an officer will be given the opportunity to travel, renew his acquaintance with citizens at home, meet interested groups, speak about the work of his Department, write and publish, are all matters requiring clarification. Leave should be viewed not simply as a vacation, but rather as a necessary educational process for the returning officer and an opportunity for valuable contact between the Department and the Canadian public.

Finally, the position of women in a department that has traditionally provided careers for men only, warrants a brief comment. There were at the time of review sixteen women officers in the Department, ranging in rank from probationer to ambassador. In general, the woman officer is given reasonable opportunities to develop and progress, but there is no doubt that her expectation of a senior career is much less promising than is the case of a man. Obviously entertainment and dealing with senior male civil servants and officers of other missions present difficulties for the woman officer. Nevertheless, there is wide scope for a more imaginative use of female officers, and it would be unfortunate were the Department to fail to draw on the talents of the rising generation of women university graduates. It is possible, for example, that the proposed increase in the number of permanent positions, especially in such supporting divisions as the Legal, Historical and Research Divisions, or in a functional division, such as the Economics Division, could provide more satisfactory career prospects for the female officer.

Efficient secretaries are indispensable for the immense mass of drafting—telegrams, despatches, memoranda, etcetera—characteristic of the work of a Foreign Office. In Ottawa, the ratio of secretaries to officers is relatively low and the establishment is seldom filled. This, of course, represents both strain and additional cost. An upgrading of this classification, possibly with a view

to attracting women university graduates, might improve the situation, particularly if ancillary research assignments were made part of the job. This would also provide a better ladder of promotion and a better source of recruits for promotion to the Principal Clerk, External Affairs Officer and Foreign Service Officer classes. The secretarial problem abroad is primarily attributable to the personal loneliness of the secretary posted from Canada. Reference to this problem will be made later in this report.

3

ADMINISTRATIVE AND SUPPORTING SERVICES

Reference to the present organizational plan of the Department shown in Chart 1 reveals a general mix of divisions having political and administrative functions. The suggestion has already been made that the broad differences in the character of these activities be recognized by organizing each under its own deputy under-secretary. At present there are six administrative divisions respectively in charge of:

- Administrative Services
- Communications
- Inspection
- Personnel
- Supplies and Properties
- Liaison Services

In addition there are divisions providing supporting staff services such as the Information, Historical and Legal Divisions.

In the group of reports dealing with *Supporting Services for Government* your Commissioners deal with many of these services on a government-wide basis and in certain cases make critical comment about the manner in which the Department of External Affairs is meeting its special needs. Recognizing the extent of present organizational weaknesses in the Department, your

Commissioners have nevertheless recommended the assignment to it of certain additional responsibilities in co-ordinating or facilitating the provision of supporting services for the foreign operations of other departments and agencies. The more important of these recommendations may be briefly summarized as follows:

- The operations of a communications network outside Canada to serve all departments and agencies other than those served by their own special systems (*see report on Communications*).
- The maintenance of a travel office responsible for making foreign travel arrangements for all members of the public service (*see report on Transportation*).
- The constitution of an expert legal service to which all departments and agencies should submit questions of international law (*see report on Legal Services*).
- The provision of active leadership in co-ordinating the external information and publicity activities of all departments and agencies (*see report on Public Information Services*).

Still other recommendations of your Commissioners would bring about a transfer of responsibility from the Department to common service agencies for two important supporting services:

- The designating of the Department of Public Works as the agency responsible for real property management both in Canada and abroad (*see report on Real Property Management*).
- The development of a common procurement agency which would assume responsibility for purchasing and supply, serving both the headquarters of the Department and its missions abroad (*see report on Purchasing and Supply*).

The reasons underlying these various recommendations are set out in the reports cited and need not be repeated here. In this report it is necessary to refer only to particular aspects of the organization for supporting service within the Department.

STAFFING THE ADMINISTRATIVE SERVICES

It is within the supporting services of the Department that the policy of rotational postings has had its most damaging effect. The basic conclusion

is that, in pursuing the development of the generalist foreign service officer, administrative and supporting services should be excluded from the training and rotational areas. This conclusion rests on two considerations. First, the scale and complexity of supporting services is now such that in attempting to train the officer corps by rotation through these areas, the end product is likely to be not so much the well-rounded foreign service officer with some specialized abilities, as the jack of all trades—and master of none. Second, the imperative need of the Department for strong and effective supporting services cannot be satisfied without the employment of skilled management and stable personnel arrangements. The assignment of these responsibilities, on a short-term basis, to amateurs as part of their training for a foreign service career closes the door against administrative efficiency.

Several years ago, the Department sought to introduce a programme for developing a better qualified administrative group with genuine career prospects and designed to provide the kind of administrative structure that a rotational foreign service needs at home and abroad. This programme was built around a new class entitled External Affairs Officer (EAO) which, it was hoped, would open up opportunities of promotion for other administrative staff and in turn serve as an avenue into the Foreign Service corps. These expectations have not been fulfilled, partly because the director of the programme left and there were neither staff nor facilities for the necessary training programme. The anticipated movement from “principal clerk” to EAO has not materialized and the system shows no signs of becoming an avenue for promotion to anything. Although a few senior consular openings and at least one ambassadorial post have been filled with senior EAO’s, most of the individuals in this class are bunched at grades 1 and 2, with limited career prospects.

The experience of the United Kingdom Foreign Office with its “Branch B” administrative structure is fundamentally sound in a Foreign Office and it would, therefore, be valuable to have something approximating this structure in the Department of External Affairs under the proposed Deputy Under-Secretary (Administration). This proposal assumes a certain mobility between the personnel of “Branch B” and the Foreign Service Officer Corps, should any of the administrative personnel in “Branch B” indicate a talent for the political side of the Service.

The nature of the Department’s operations dictates the need for provision of supporting services not only at headquarters but also to the missions abroad. This calls for the posting abroad, particularly to large and medium sized missions, of administrative personnel. It is clearly uneconomic to divert the attention of foreign service officers from their main task by giving them

administrative duties where any possible alternative exists. One such is the use of more locally-engaged personnel. At foreign posts of other departments, especially Trade and Commerce, long-term locally-engaged personnel have proved to be valuable adjuncts in handling accounts, mission dealings with the local government, information, translation and first-level consular or immigration matters. It was observed at a number of posts abroad that the senior locally-engaged personnel provided continuity and stability in the administrative work. The economies inherent in such arrangements reinforce the argument for reconsideration of present policies.

The reason usually advanced against the more widespread use of locally-engaged personnel is the need for security. The enquiries of your Commissioners led to the conclusion that an over cautious attitude in this matter is leading to unnecessary expenditure on a significant scale. In the name of security, junior personnel, male and female, are being posted around the world at considerable expense and at an indeterminate further cost in the complicating of personnel administration at the foreign missions. Recognizing that greater precautions are needed in some missions, your Commissioners believe that in others substantial savings can be made by replacing personnel posted from Canada with local residents whose reliability can be established by appropriate checks.

NOTES ON INDIVIDUAL SERVICES

Communications

The volume of communications, in the form of telegrams, between head office and the missions abroad has expanded greatly since the development of a telex communication network using automatic cypher. About half the missions are now served by this system, on which \$750,000 has so far been spent, and it is planned in time to interconnect all the foreign posts. Annual operating costs approximate \$1,800,000, with over one hundred employees engaged in the work of the Communications Centre in Ottawa. It is pertinent to observe that this division is staffed at headquarters by non-rotational personnel who have the special skills for this highly technical function.

Efficiency of operation and the economies made possible by improved technology have reduced considerably the unit cost of messages, but substantial increases have occurred in the traffic, with the result that total communication costs have actually increased. A study of the activities of eleven missions revealed an increase from 6,000 telegraphic messages in 1954 to over 75,000 in 1961. In the same period communications by mail decreased by twenty-five per cent. A second study of four missions showed that in the year follow-

ing installation of telex and automatic cypher the annual flow of messages increased from a level of 600 to almost 2,300, while mail communications declined from 1,323 to 1,197. The consequence of making available efficient and relatively inexpensive telecommunications has been to induce a veritable flood of messages which adds to paperwork costs and threatens to engulf those whose duty it is to read and digest them.

To bring this situation under control and achieve orderly use of the several methods of communication available, senior management, both at headquarters and in the missions, must lay down guide-lines. With modern air services, the mails today move so rapidly that a decrease in their use by the Department is astonishing indeed. Telex messages need to be monitored, not only to assure that the urgency of their contents warrants telegraphic despatch, but also to control their length by avoidance of verbosity.

The recommendation that the Department's telecommunication network form the core of a system to serve all departments of the government provides an additional reason for preventing abuse of these facilities. The whole purpose of this recommendation will be frustrated if the Department monopolizes the system for the despatch of messages that lack the element of urgency.

Paperwork Procedures

The flow of paper from the missions abroad and circulating within the Department has been increased by the new communication facilities mentioned above. Paper can be both a blessing and a plague in a Foreign Office. As your Commissioners observe in their report on *Paperwork and Systems Management*, paper constitutes the vital mode of communication as well as the memory of an organization. It is a plague when its volume cannot be controlled or when the information it contains lies buried in poorly organized files. Your Commissioners' strictures on the inadequacies of paperwork and systems management throughout government apply with particular force to the Department of External Affairs: not only is the flow and distribution of paper inadequately regulated, but the system of files and records control leaves much to be desired.

The volume of paper could be reduced by instituting a programme of editorial control; a possible pattern is the system in the British Foreign Office. More precise instructions with respect to the direction of telegrams "for information" could also curtail the unnecessary circulation of paper within the Department. Present procedure allows the sender to determine who gets what, with the result that it was observed that the Canadian mission at The Hague was receiving a large volume of material dealing with Laos. Weekly or fortnightly summaries would suffice. In the Ottawa divisions the number of tele-

grams circulated each day has reached the point where, too frequently, they are being read only by the divisions directly concerned. An orderly screening of these telegrams to determine distribution and a digest of their content for quick reference would make the daily pack of telegrams more useful. The practice followed in the State Department in the United States of producing a morning digest might well be considered by the Department of External Affairs.

The weaknesses of the filing and registry systems in the Department are such as to affect adversely the quality of the work performed by the operating divisions. Your Commissioners' recommendations made elsewhere for an upgrading of the status and qualifications of those engaged on filing and registry work are particularly relevant to this Department. These branches suffer from shortage of qualified staff, from heavy turnover and from an attitude that views the registry as a kind of manning depot. Without some permanency of staff, the registry and filing system will not receive the skilled attention which the importance of its services to a paper-breeding department like External Affairs obviously warrants. The registries in the missions abroad require similar strengthening by persons with training and should be handled in accordance with clearly defined programmes laid down by headquarters. Placing the registry in the Communications Division would provide a more natural home for its operations, associated as they are with the telegrams which occupy an increasingly significant role in all files.

The defects in the filing system and the registry of External Affairs have been a matter of concern for a number of years. There exists, in fact, a recent forthright report on the files which offers positive solutions along appropriate lines, but it has not produced results. Your Commissioners stress the need for immediate remedial measures.

An allied problem is the operation of the Historical Division and the departmental library, both of which are also essential to research and the preparation of background papers required by all operating levels in the Department. Both the library (parts of which are physically separate) and the Historical Division are not suitably staffed for their purposes. Consideration might well be given to enlarging the Historical Division to include a research section staffed by non-rotating specialists. The employment of several professional non-rotating librarians, particularly for the documents section, and the enunciation of a general library policy are requisites in strengthening this service arm.

Purchasing and Supply

The recommended transfer of this function to a common service agency will largely relieve the Department of future responsibility for the purchase of

a host of items for use in Ottawa and abroad. Your Commissioners refrain from developing a detailed prescription for the administrative arrangements required, but point out that the central agency will have to develop certain facilities abroad to be in a position to render prompt and economical service to the client departments. Such a devolution will, however, be largely ineffectual unless accompanied by the granting of substantially greater freedom to the heads of mission to authorize expenditures for local purchases. Present expenditure limits are ridiculous, in most cases limited to \$50 a year. The raising of these limits, and allowing the head of the post to exercise discretion, would eliminate a mass of unnecessary paper work, put an end to vexatious delays in the supply of minor necessities, and reduce the frustrations induced by unnecessarily cumbersome control procedures.

Housing

The government has invested approximately \$8 million in real property abroad to provide housing and office accommodation for the missions of the Department. Additional properties are held under lease at an annual rental cost of \$640,000.

OFFICIAL RESIDENCES. Approximately twenty heads of mission are currently housed in properties acquired by the government at a total cost of over \$3 million. The most costly is the residence in Paris for which \$465,000 was laid out. Two others each cost more than \$300,000 and another eight were acquired at costs ranging from \$100,000 to \$300,000. Other heads of post are housed in rented residences or apartments, the rental cost of which last year aggregated \$240,000. The range of annual rentals includes four rentals exceeding \$12,000 annually, seventeen rentals from \$5,000 to \$10,000 and sixteen below the \$4,000 level.

Varying price levels in different countries render the foregoing comparisons somewhat inconclusive, but in terms of actual accommodation a wide variation is apparent in the style and size of residences. Some are quite modest while others are elaborate or even pretentious. However, neither the financial aspects nor the physical character of the respective properties appear to bear any consistent relationship to the size and importance of the mission and the system as a whole displays a patchwork quality which indicates a lack of long-range planning.

CHANCELLERIES. The cost of chancelleries or office accommodation abroad exceeds both in investment and annual rentals that for official residences. The physical properties owned are in London, Paris and Washington: most other

missions operate in rented offices. Rentals from country to country are much more consistent than those paid for residences and the actual standard of accommodation shows less variation. In some of the larger centres all Canadian government activities are housed under one roof and there is some support for the view that this practice should be followed more generally. Added prestige, better security, closer interdepartmental relationships, and exemption from local taxation are among the advantages to be realized. On the other hand, a single location is rarely satisfactory to all departments and the clientele visiting Canadian offices is not necessarily homogeneous. Your Commissioners' view is that the decision in each centre should depend on local circumstances. Inspection of a number of these offices leads to the strong conviction that a greater effort should be made to create a more attractive atmosphere with some Canadian flavour. Present offices often tend to be drab and indistinguishable from neighbouring premises.

STAFF HOUSING. Housing for those posted abroad creates perennial difficulties. Abroad, the Department owns or leases one hundred flats for its staff, mostly in areas where it is difficult to obtain accommodation. These apartments are furnished by the Department. There are complaints that this policy has not been pursued with sufficient vigour and that there should be a policy of long-term lease or ownership of housing for the number two of a mission. In general, while much attention and money has been devoted to residences for the heads of missions, a more orderly policy for providing staff accommodation abroad is required.

The survey made lends support to the policy of providing living quarters, as long as standards are appropriate to the rank of personnel accommodated. In certain cities where suitable accommodation is in short supply, serious waste of money and time is involved when a highly paid officer must spend weeks, some times months, searching for living quarters and in the meantime living at public expense in hotels.

Plans are now being made for enlarging the programme for the housing of staff and careful organization will be needed to achieve optimum results. Fairness and consistency must characterize the methods adopted since they may have marked effect on employee morale.

For those officers posted home, there is only a two-weeks resettlement allowance. Often this leads to the hurried purchase of a house or an unsatisfactory lease on an apartment. An experienced individual in Ottawa might well be made responsible for maintaining detailed lists of suitable accommodation, notifying officers before their posting back to Ottawa, and generally providing competent advice to those concerned.

CONCLUSIONS. With the adoption of your Commissioners' recommendation for the transfer of responsibility for all real property management to the Department of Public Works, a careful study of the whole problem of foreign premises should be carried out and recommendations for future policy in this field submitted to the Treasury Board, after consultation between the Department of Public Works and the other departments and agencies engaged in foreign operations.

Personnel Management

The management of personnel in a foreign office is fraught with more than the usual number of difficulties when one considers the need for planned assignments of staff at home and throughout the world. That the Personnel Division in the Department of External Affairs should be strengthened is both obvious and pressing; it appears to be in arrears with its work and unquestionably the system of rotation at the senior level of direction is a plague. In the report on *Personnel Management*, and in other reports, your Commissioners stress that every department must have a skilled personnel officer who is well informed about the public service and who may be shifted from department to department. Application of this recommendation to the Department of External Affairs will bring about sophisticated personnel planning and promote training programmes that are now lacking.

4

SPECIAL ACTIVITIES

Lying somewhat outside the regular run of the conduct of international business and foreign policy development, are two operational activities of importance which are examined in this chapter.

PASSPORT OPERATIONS

The issue and renewal of passports and certificates of identity is a growing (and profitable) activity of the Department, as indicated by the following comparisons:

Table 3—VOLUME AND VALUE OF PASSPORTS AND CERTIFICATES OF IDENTITY

Year	Passports		Certificates of Identity		Revenue
	Issued	Renewed	Issued	Renewed	
1955	79,228	12,474	4,601	2,277	\$428,262
1958	100,594	15,446	3,276	801	549,069
1960	134,637	18,411	6,004	2,184	730,605
1961	139,218	19,987	4,237	3,209	746,796

Fifty years ago few countries demanded that visitors identify themselves by means of an official passport. Canada had no passport facilities of its own, such passports as were required being issued from London. The Parliament of Canada has never enacted legislation requiring a person, either entering or leaving the country, to possess a passport, but regulations made by the Governor in Council under the *Immigration Act* require it of immigrants. The cur-

rent requirement by foreign countries, excepting the United States, that visitors from Canada present passports when seeking admission has resulted in the universal possession of passports by Canadians who travel outside North America.

A passport simply requests those "whom it may concern to allow the bearer to pass freely without let or hindrance and to afford the bearer such assistance and protection as may be necessary." A passport may not be demanded as of right and its issue or renewal constitutes an exercise of the Royal prerogative. While accepted generally as a document of identity, the passport does not purport to guarantee the accuracy of the information it contains. In the absence of verification of the facts recited in a passport application, there exists ample opportunity for irregularity and fraudulent misrepresentation.

The grant of Canadian passports based on fraudulent representations occurs sufficiently frequently to call for reconsideration of the traditional practices of the Department, in order to preserve the good name of Canada abroad. The basic existing safeguard is the requirement that each application be supported by a declaration of a guarantor, that he has known the applicant for two years and that to the best of his knowledge and belief the declarations in the application are true. This declaration is neither witnessed nor made under oath. Since the end of World War II the list of acceptable guarantors has been enlarged—as a convenience to the public—and now includes all mayors of municipalities, magistrates, police officers, postmasters, collectors of customs, clergymen, lawyers, notaries, doctors, dentists, school principals, chartered accountants, professional engineers and bank and trust company managers. Such a list, especially in urban centres, embraces a great many individuals and where abuses occur, the pertinent provision (section 58) of the Criminal Code is one not easily enforced. Under present practice the guarantor is presumed to exist and to be both occupationally qualified and a person whose word is as good as his bond. A more effective check of the *bona fides* of guarantors is desirable, but this is something that a department without a chain of offices across Canada is ill-equipped to perform.

The operation of the Passport Office of the Department involves little more than a clerical function and the large volume results in a low unit cost for the processing required. Thus, fees charged, though unchanged for many years, exceed direct operating costs by approximately \$300,000 a year.

Like most foreign offices, the Department of External Affairs is traditionally responsible for the issue of passports and on it rests the duty of taking a continuing interest in holders when they are abroad. The latter duty is a logical one for a Foreign Office, but your Commissioners question whether the

Department should continue to be responsible for the working of the Passport Office.

Throughout the reports of this Commission, stress is laid upon the need to avoid duplication of effort in public administration and the recommendation is frequently made that departments best equipped to render specialized services act in an agency capacity for other departments when this will promote efficiency and economy.

In Canada, the department directly concerned with national origins, naturalization and citizenship is that of Citizenship and Immigration, which maintains comprehensive records of the citizenship status of many individuals. In these circumstances the appointment of the Department of Citizenship and Immigration as agent for the Department of External Affairs for the issue and renewal of passports would be logical and in the interests of efficiency. Such a move could also contribute to the convenience of the public since the Department of Citizenship and Immigration possesses a branch organization which would permit the verification of passport applications in the principal cities of Canada, and, in addition, facilitate a continuing scrutiny of guarantors.

EXTERNAL AID OFFICE

The Department of External Affairs spent over \$93 million in the 1962 fiscal year, of which \$28 million represented operating costs of the Department—an increase of over \$6 million since 1960. The balance consisted largely of various forms of assistance to other countries, the \$50 million spent on the Colombo Plan being the major single item. These outlays were undertaken in support of programmes to improve conditions in under-developed countries. Power plants have been constructed, irrigation schemes assisted, fisheries programmes promoted, and vast quantities of foodstuffs, industrial equipment and commodities have been supplied. Canada has furnished many technicians, teachers and other specialists to these countries and, in turn, their students are assisted when they come to Canada to further their education.

As a by-product of Canada's involvement in world affairs, these programmes have come into being under the guidance of the Secretary of State for External Affairs who is accountable to Parliament for their conduct. In recognition of the growing importance of such activities, operating responsibilities were transferred in 1960 from an interdepartmental organization to an External Aid Office which, at the time surveyed, was administering Canadian participation in the following:

- The Colombo Plan,
- The Commonwealth Technical Assistance Programme,
- The Commonwealth Scholarship and Fellowship Scheme,
- The Special Commonwealth Africa Aid Programme,
- The Programme of Canadian Aid to French-speaking Countries in Africa.

The External Aid Office is treated, for administrative purposes, as a special agency of the government reporting to the Secretary of State for External Affairs. Its administrative and staffing costs, about \$575,000 last year, are included in the expenditures of the Department and staff is seconded to it from the Department. The Office is not a body created by statute but consideration might usefully be given to the passage of legislation for its governance, defining more explicitly the degree of its independence from the Department.

In this connection it should be noted that, because programmes are carried on outside Canada, only the Department of External Affairs is in a position to assess performance in terms of the wise application of these large funds. If such assessment is to be impartial, the External Aid Office should be independent of the administrative direction of the Department. The latter cannot sit in judgment on itself.

GRAND TOTAL = 1819

5

CO-ORDINATION ABROAD

The expansion of the Department of External Affairs' system of foreign missions has been accompanied by significant growth in the establishments of other departments abroad to meet an increasing range of specialized commitments. In June, 1961, twenty-seven departments and agencies had 2,853 employees scattered throughout 104 cities outside Canada. One-half of these are employed by the Department of External Affairs. These figures do not include the offices of commercial Crown corporations or of the Armed Services.

There is a substantial concentration of staff, 37 per cent of all employees being located in six cities. Not all of these employees were recruited in Canada and posted abroad: over one-half are locally engaged and ordinarily resident in the host country. Most of these locals are employed on relatively routine work and some have long service in the government's employ, e.g., thirty to forty years in the United Kingdom.

The numbers of Canadian and locally engaged personnel employed by the departments principally involved are shown in Table 4.

The offices abroad (in June 1961) of all departments and agencies are shown on Chart 2. In London, England, twenty-one different departments and agencies maintained offices, but there were 37 cities in which one department only had an office or mission. In 25 other cities both External Affairs and Trade and Commerce (but no others) had offices and in a further 34 cities three or more departments were represented. It is in this latter group that evidence of maldistribution of manpower and duplication was most frequently found.

Table 4—EMPLOYEES AT OFFICES OUTSIDE CANADA—JUNE, 1961

<i>Department or Agency</i>	<i>Posted from Canada</i>	<i>Locally Engaged</i>	<i>Total</i>
External Affairs	731	694	1,425
Trade and Commerce	155	313	468
Citizenship and Immigration	113	247	360
National Health and Welfare	56	86	142
RCMP	45	23	68
All Others (22)	160	230	390
TOTALS	<u>1,260</u>	<u>1,593</u>	<u>2,853</u>

Inquiries made in a number of representative cities abroad revealed a serious lack of co-ordination between the offices of the several Canadian departments and agencies represented. The situation is characterized by waste and misuse of manpower; a reluctance to rely on the skilled resources or administrative services of other departments because of the pervasive departmental attitude of self-sufficiency; inflexible establishments, ill adapted to changing workloads; and, more generally, a compartmentalization that is wasteful and weakens Canada's representation abroad.

The assignment of personnel to posts abroad to perform only those duties prescribed by a particular department can have ludicrous results, as illustrated by the immigration missions in Europe. On the continent of Europe a minimum immigration mission consists of: an officer of the Department of Citizenship and Immigration who conducts the civil interview and issues the visa; a doctor from the Department of National Health and Welfare who medically examines the applicant; a member of the RCMP who conducts the security interview; usually a secretary for each, who acts as interpreter; and clerical staff for processing documents. None of these departmental representatives is permitted to perform the tasks of the others; in fact, the doctor is under orders to maintain his own administrative staff and telephone separate from the others.

One immigration officer cannot process enough applicants to keep a doctor and an RCMP officer busy, even if the applicants are lined up at the door, which they are not. Minimum staffing for an efficient immigration mission requires two or three immigration officers plus a doctor and an RCMP constable, and the mission should process about 5,000 immigrants a year. Since there are few currently operating on such scale, many of our immigration missions are no longer economically justifiable as independent offices, and

the resulting idleness imposed upon the Canadian staff not only represents monetary waste but is destructive of morale. An obvious solution is to integrate the immigration work with that of other departments and agencies in the same city, which necessarily involves a relaxation in the present rules prohibiting individual employees from performing more than a single specified task.

In the area of administrative services many examples of lack of co-ordination were observed. There is no valid reason to accept the waste that results from the existing compartmentalization. Five departments under one roof in the Chancellery in Paris operate independent administrative units. In London, the Treasury Office provides centralized accounting and Public Works offer some common services, but eight departments and agencies employ administrative officers, six of them in the same building.

There is ample evidence of a need for broad supervision of the activities of the various departments and agencies by a senior representative of the Canadian government. The immigration office in London has processed an average of ten thousand immigrants a year for the last three years. Medical examinations for this volume would require the services of two or possibly three doctors. Nevertheless, the Department of National Health and Welfare recently took over and equipped an entire floor of the Sir John A. Macdonald Building, staffed it with fifteen doctors and twenty-eight clerks and technicians and installed x-ray facilities capable of handling one thousand persons a day. At the Hague, the Ambassador, at the time of the inquiry, was keeping in close touch with the immigration mission a few blocks away from the Chancellery but was powerless to put to other use any of the four immigration officers, four doctors, two RCMP officers, and an administrative staff of twenty-six when the workload dropped to about one-tenth of their rated capacity.

THE HEAD OF POST

An ambassador or high commissioner is not just the head of the External Affairs mission; he has the over-riding answerability to the host country for the manner in which Canadian government activities are conducted, and so should exercise a general supervisory role. Unfortunately this has never been clearly stated for the guidance of departments, nor may it be said that Heads of Post make it a practice to concern themselves with the affairs of other departments. Surveys made point to the conclusion that departments stoutly resist any local direction of their own affairs, although accepting a subordinate role in matters relating to representation and diplomatic privilege. Two major exceptions to the lack of authority of the Head of Post were noted, and they provide an interesting contrast: one has *de facto* authority without

statutory basis, the other has statutory authority which he is unable to exercise. The North Atlantic Treaty Organization mission in Paris is a highly integrated operation with all administrative services provided by the Department of External Affairs. Personnel of various departments, assigned to the mission, carry out a wide variety of duties, but these assignments may have no direct bearing on their particular departmental interests. All the various departmental representatives unquestioningly work under the detailed direction of the Ambassador and the arrangement works most satisfactorily.

The High Commissioner in the United Kingdom Act states that the High Commissioner shall "supervise the official activities of the various agencies of the Canadian Government in the United Kingdom". The principle embodied in this stipulation was recognized in 1922 in the face of a condition of waste, confusion and overlapping very similar to that existing today. While over the years there have been instances of intervention by the High Commissioner, it is fair to say that the managerial role envisioned has never been developed. There is today no integrated administrative machinery and the High Commissioner has no means of assessing the performance of the offices for which he is statutorily responsible.

The evidence gathered by your Commissioners leads clearly to the conclusion that, not only in London but wherever two or more departments have offices in a foreign country, there should be senior supervision and co-ordination. Moreover, to be effective this task must be performed on the spot and there seems no real alternative but to place the responsibility on the Ambassador or High Commissioner. He is the official who represents the Government of Canada as a whole in the host country. He is best able to assess local needs and deploy available resources to meet requirements, and is in a position to communicate directly with the ministerial heads of departments. The assumption of responsibility for co-ordination should not, however, closely engage the head of post in the substantive work of other departments; he should bear no responsibility for the manner in which local personnel respond to the instructions of their several departments. His duty in the briefest terms should be to see that the personnel in his area are kept working effectively and that the talents available are employed to the best possible effect in the interest of the government as a whole.

ADMINISTRATIVE SERVICES

A requirement, closely related to the foregoing, exists for avoidance of duplication of administrative services. The recommendation has been made elsewhere that the Department of Public Works assume responsibility for all

real property management abroad; also that External Affairs handle telecommunications with Ottawa for all departments. There remains, however, a number of supporting services in organizing for which there is danger of duplication and waste in countries where a number of departments are represented. No single formula is offered. However, your Commissioners believe that an administrative career service is required in the Department of External Affairs. Further, since the Department now employs over half of the administrative staff abroad, consideration should be given to the use by other departments and agencies of External Affairs administrative services where local circumstances permit.

Over fifty per cent of all Canadian employees overseas are locally engaged and serious consideration should be given to the greater use of such personnel. The experience of the Department of Trade and Commerce with locally engaged commercial assistants demonstrates that local employees can be recruited who are capable of dealing with more than routine administrative work. The advantages of an effective usage of locally engaged personnel are not to be measured in money alone; the local employee knows the language and customs of his country and can prove to be an invaluable bridge to the Canadian in a foreign environment. In addition, the local employees provide an important measure of continuity to a post staffed by Canadians rotated on tours of duty. A basic requirement for the successful use of locally engaged personnel is fairness in remuneration and other benefits. Because local employees work side by side with Canadians, major differences in such matters as pension rights have a bearing upon morale and the esteem in which the Canadian government is held as an employer by the local staffs.

The proliferation of small departmental units abroad is wasteful alike of manpower and money. Wherever practicable, in lieu of establishing or continuing an existing small office, the department concerned should seek an arrangement whereby another department that necessarily operates an office in the locality acts as its agent. In some cases a simple agency arrangement will suffice, while in other instances specialists may need to be seconded.

6

RECOMMENDATIONS

The headquarters organization suffers from a lack of separation between divisions engaged in the substantive work of the Department and those charged with provision of administrative and supporting services. The efficiency of the Department will be improved by placing the responsibility for each of these areas of activity upon a Deputy Under-Secretary of State and making a corresponding re-alignment of the various divisions.

We therefore recommend that: The operations of the Department in the political field be placed under a Deputy Under-Secretary of State (Political) and all administrative and supporting services be provided under the direction of a Deputy Under-Secretary of State (Administrative).

In the training and development of foreign service officers there is need for more intensive training and instruction during the probationary period. In their future development, the divisions to which foreign service officers should be posted upon their return to Ottawa should exclude the administrative and supporting services. As a consequence, the period during which such officers are posted outside Canada should be adjusted to harmonize with the number of non-administrative positions available at headquarters for their further training and development.

We therefore recommend that: 1 The preliminary instruction of probationary foreign service officers be expanded.

- 2 In managing the rotation of foreign service officers the positions to which they are posted upon return to Ottawa be confined mainly to those within the political divisions of the department.

The evidence suggests that improvement is required in the skills and experience of the foreign service officers in charge of the various headquarters divisions. Further, properly to discharge their supervisory duties, divisional heads should be provided with deputies on a broader scale than at present.

We therefore recommend that: The positions of divisional head be staffed with more senior and experienced personnel and deputies be provided to them where necessary.

With the recommended withdrawal from the administrative and supporting services of foreign service officers serving on a rotational basis, the need arises for staffing the various service divisions with personnel of the requisite skills and experience. To preserve reasonable continuity of management a number of such personnel will require to be stationed permanently in Ottawa and such rotation with posts abroad as may be required must avoid any weakening of the headquarters services.

We therefore recommend that: Supporting and administrative services be staffed with experienced personnel possessing such special skills as may be required.

As a means of providing better career opportunities for administrative personnel and creating a ladder of promotion to the more senior positions, as well as facilitating transfers of individuals between the administrative staff and the foreign service corps, consideration should be given to creating a single career service for administrative personnel which would parallel that of the political branch.

We therefore recommend that: Consideration be given to the development of an administrative career service within the Department.

The rather limited career opportunities for capable women within the Department suggests the desirability of attempting to recruit a larger proportion of well-educated women and assigning them to senior secretarial duties

with opportunity to participate in research activities. The recruitment of women of superior capabilities could well lead to a strengthening in both the political and administrative phases of the activities of the department.

We therefore recommend that: An attempt be made to increase the employment of female university graduates with a view to assigning them in particular to senior secretarial and research duties.

As a result of what appears an over-cautious approach to the question of security at posts abroad, the extent to which local staff is engaged and entrusted with responsible work now appears unreasonably low. The greater use of locally engaged personnel could result in important savings without unduly endangering the maintenance of necessary secrecy, except at sensitive posts. An increase in the use of locally engaged personnel would be particularly effective in reducing rotational requirements for administrative personnel, and experience of other departments shows that they may be entrusted with quite responsible work.

We therefore recommend that: Steps to be taken to increase the number of locally engaged personnel at posts abroad.

A study of the nature and volume of telegraphic communications between headquarters and the posts abroad revealed very sharp increases in the use of telecommunications facilities. At the same time there were reductions in the number of messages sent by post. Unless the communication facilities of the Department are properly managed the available facilities will be inadequate for the larger task recommended, whereby the network of the Department will become available to all departments and agencies.

We therefore recommend that: The Deputy Under-Secretary of State (Political) and the Deputy Under-Secretary of State (Administrative) be made severally responsible for the prevention of misuse of telecommunication services by their staffs, both in Ottawa and the field.

The management of the Department's paperwork, in particular its filing and registry system is in most urgent need of re-organization. Until such is undertaken the effectiveness of the Department will continue to be impaired.

We therefore recommend that: The filing system and registry at headquarters be re-organized forthwith, with experienced staff assigned thereto on a permanent basis, and

instructions be issued to all posts abroad for the adoption of common paperwork procedures.

The present regulations whereby local purchases on the authority of heads of post are limited, in most cases, to \$50 a year are unrealistic. The adoption of more sensible limits will significantly reduce unnecessary communications, frustration and delay.

We therefore recommend that: Limits of expenditures to be made at posts abroad within the discretion of the head of post be increased substantially.

An element of duplication exists in the operation of the passport office by the Department of External Affairs and the maintenance by the Department of Citizenship and Immigration of extensive records of the national status of individuals. A transfer of responsibility for the operation of the passport office to the latter Department would appear logical; moreover, the convenience of the public would be served through the opening of passport offices in the principal cities of Canada.

We therefore recommend that: The operation of the passport office be assumed by the Department of Citizenship and Immigration as agent for the Department of External Affairs and consideration be given to the acceptance of passport applications in the principal cities of Canada.

The inspection made of selected offices abroad reveals unmistakable evidence of waste and duplication on a large scale. In the absence of any co-ordination or local control, the continued independence of the various Canadian government departments and agencies in the operation of their foreign posts cannot but worsen the present conditions. Having regard to the constitutional position of the Head of Post, the solution appears to be to place on him the responsibility for the control and co-ordination of all Canadian government activities in the country to which he is accredited, other than activities of the Armed Forces.

We therefore recommend that: At posts abroad, the Head of Post be made responsible for the supervision and co-ordination of all activities of civil departments and agencies of the Government of Canada.

22 NORTHERN AFFAIRS

SPECIAL AREAS OF ADMINISTRATION

REPORT 22: NORTHERN AFFAIRS

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In the course of the inquiry your Commissioners also had occasion to draw on the knowledge and experience of:

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- E. J. Gall, *Hudson's Bay Company*, Yellowknife; elected member of the Northwest Territories Council, Yellowknife, Northwest Territories
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- Rev. Father J. T. Mulvihill, O.M.I., *Oblate Fathers Indian and Eskimo Commission*, Ottawa, Ontario
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Your Commissioners, in acknowledging the assistance and advice received, dissociate all those named above from any of the findings and conclusions contained in this report; for these, your Commissioners assume full responsibility.

1

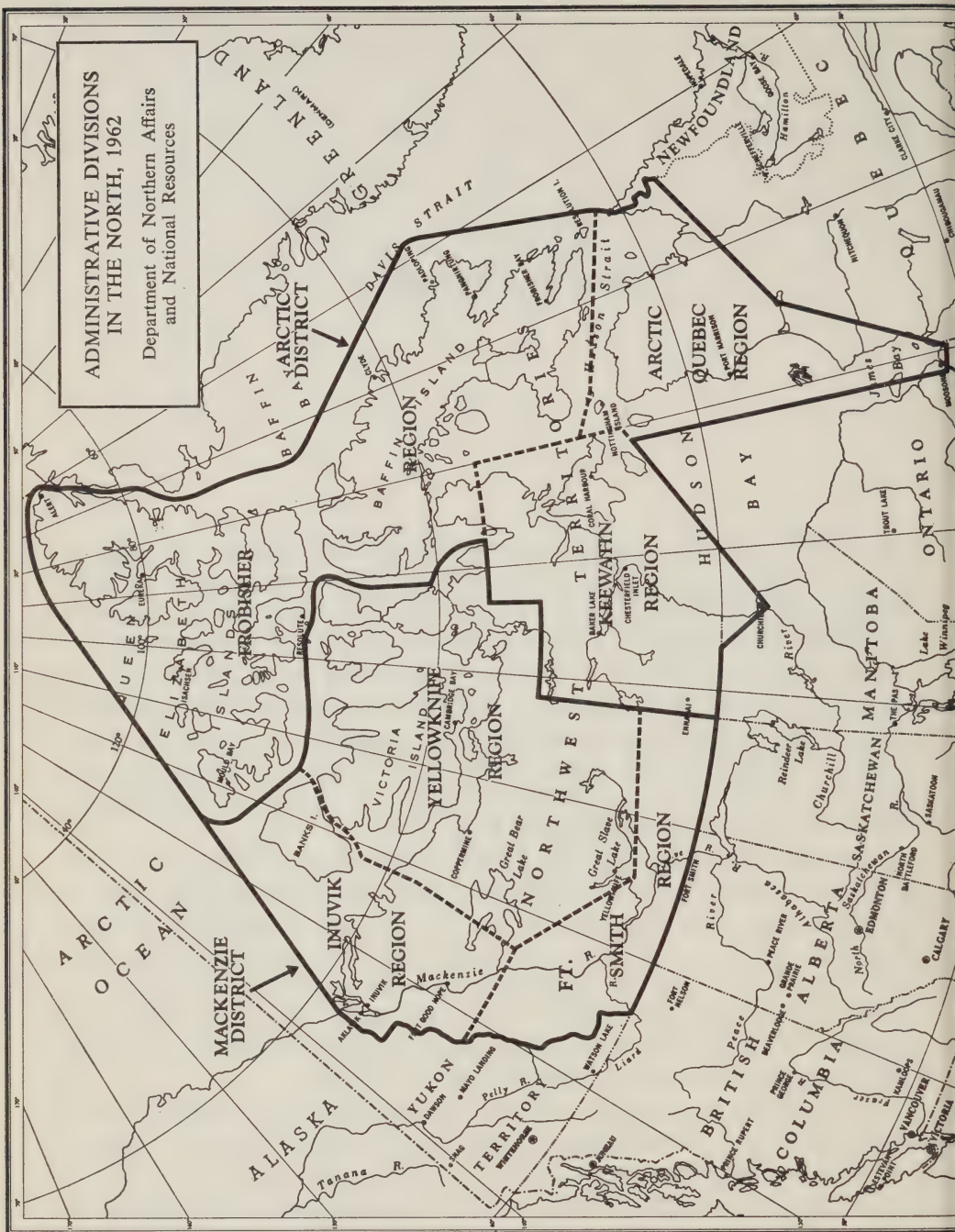
INTRODUCTION

In most of the preceding reports, and especially in the first and second volumes, the organization and methods of operation of the federal government have been appraised in the light of the economic, social and political conditions familiar to most Canadians. By and large, the findings and recommendations relating to the management of the public service and the organization of its supporting services have assumed a background of settled and productive communities, resting on a well-established economic base, served by transportation, communications and the other public utilities, and enjoying high standards of public order, health, education and welfare administered by experienced provincial and municipal authorities.

Throughout more than half the country, however, these conditions do not prevail. As a rough guide, the fifty-fifth parallel of latitude may be taken as the dividing line (see map). Beyond this lies the North, rigorous in climate, much of it barren in appearance, and containing in its vastness less than one-half of one per cent of the Canadian population: the Yukon Territory has 11,900 whites and 2,200 Indians in its 205,000 square miles, while the Northwest Territories, extending over 1,300,000 square miles, have a population of 8,900 whites, 5,300 Indians and 8,000 Eskimos.

Nevertheless, the writ of the federal government runs throughout it. It is not uninhabitable—as demonstrated by the presence there not only of Indians and Eskimos but also of a growing body of settlers. The barren face hides a wealth of minerals which the discoveries of recent years are only beginning to reveal. Its importance in the defence of Canada and North America, more

ADMINISTRATIVE DIVISIONS
IN THE NORTH, 1962
Department of Northern Affairs
and National Resources



perhaps than anything else, has aroused the public to an awareness of its existence.

In their relative scale, the activities of the federal government in the North are not extensive. Of the federal public servants, scarcely more than one per cent are stationed in the North. Direct expenditures on northern administration and services account for little more than the same proportion of the federal budget. Because the costs of northern activities are seldom differentiated in government accounts from the cost of similar activities in the rest of the country, no precise figure can be given. The northern programmes of the Department of Northern Affairs and National Resources amount to roughly \$30 million a year. Something more than this is spent by other departments—especially Justice, Transport, and National Health and Welfare—for the provision of services, the promotion of health and welfare and the maintenance of order in the North. But the total impact of the North on the federal government is much greater than these figures suggest. Heavy outlays are required by a number of operations undertaken in the North for the benefit, primarily, of the southern population, such as the meteorological service and, above all, defence activities. Almost every department and many of the other agencies are concerned with the North, and more than twenty departments and agencies employ full-time staff there. Ministers and senior officials constantly encounter special northern problems in the administration of federal programmes. For one department, Northern Affairs and National Resources, the development and administration of the North is its principal concern. Thus, in any study of the organization and operating methods of the federal government, northern affairs clearly require special consideration.

In all matters of federal administration, the North provides the exception to the general rule. Climatic conditions, and the lack of transport facilities and of commonplace materials and skills, conspire to create special construction and maintenance problems. The scarcity of local suppliers and service trades—amounting, in most areas, to a total lack—complicates the task of supply. The absence of a social infrastructure—roads, communications, utilities, and community services and amenities generally—presents problems not only for the administration of government but for the very maintenance of a civilized existence by administrators drawn largely from southern Canada.

The maintenance of order and the provision of public health, education and welfare services for the scattered population, much of it still nomadic, creates problems not found elsewhere in the country. Simultaneously, the impact of southern society—spreading from older settlements in the northwest, or appearing suddenly in defence installations, mining and mineral exploration camps, transportation centres, and the new administrative outposts of the

government itself—introduces forces of change and intensifies the problems of social development and adaptation. As the old patterns dissolve under this impact, they must be replaced by a new social and economic order; but for the immediate future at least, and in many areas for as long as can be foreseen, the patterns familiar in the south will remain unsuited to the needs of northern peoples. The immediate goal, in most of the North, must be a society that resembles neither that to which the native people have been accustomed nor that in which their administrators have been reared—and one, moreover, that is constantly changing. And, as far as possible, it must offer the Eskimos and Indians a life that sustains (and in some areas restores) their self respect, that satisfies their desire to be self-supporting, and develops within them the innate urge to better their own condition. Thus economic and social development must go hand in hand.

A fundamental complication for the federal administration in the North arises from the absence, throughout most of the area, of provincial and municipal government. Where provincial jurisdiction is involved—in Labrador and northern Quebec and between the fifty-fifth and sixtieth parallels west of Hudson Bay—the pace and direction of development for the economy and its supporting services rests largely with the provinces; but the social amenities and development of most of the population—Indians, Eskimos, and the Armed Forces, federal public servants and their dependants—are largely the responsibility of the federal government. North of provincial boundaries lie the Yukon and Northwest Territories, with their major areas in varying states of political development but all requiring the federal authorities to assume, in greater or lesser degree, the duties elsewhere borne by provincial and local governments.

It is, in fact, misleading to consider “the North” as a single entity. Even in the territories beyond the provinces, there is no uniformity. The Yukon is an area of established settlements, economically and socially developed, without the special problems of an Eskimo population. Its larger communities are served by road, rail and air services and communications, and are relatively close to one another. Above all, it is an area with a history, a sense of its own identity, and the will and capacity for a high degree of self-government. In the Mackenzie basin, the settlements are strung out over more than a thousand miles, linked by air and in summer by water, and with an access road to Yellowknife; further developments of both road and rail are now planned. The Indians and Eskimos in this area have, for some decades, been in close contact with southern ways. Thus, in many respects, its condition is rapidly approaching that of the Yukon.

Quite different circumstances prevail in the eastern parts of the Territories,

which are generally accessible only by air—or at coastal points by water in the short Arctic summers—with few scheduled services. There are no natural administrative centres of gravity and existing transportation and communication facilities make Ottawa the most convenient location for the management of activities in the region. On the other hand, it is in these areas that the major mineral discoveries—of metals, oil and gas—have been made in recent years, with implications for the future that cannot yet be assessed. Thus, in this region, the District of the Arctic, major resource developments may occur in the course of time, but the pace of these developments, and their probable effects beyond the localities immediately affected, cannot be foreseen.

Despite these major regional variations, however, the federal government is faced with problems of northern policy and administration that are common throughout almost the entire North. First, there are the special problems encountered in extending to the North the policies and programmes that apply throughout the rest of the country. Second, there are the problems associated with social, economic and political development.

On the latter score, the North presents, in effect, problems of underdeveloped areas and underdeveloped native peoples similar in many respects to those of current concern internationally. And the character of these problems has a direct bearing on both the development of policies for their solution and the design of administrative machinery.

Any programme dealing with underdeveloped areas and peoples must concern itself with three questions: what can be achieved? at what pace? and at what price? There must be, in short, a clear view of both the foreground to be traversed and the goals on the horizon, and a realistic schedule of progress. A casual disregard of the foreground can only cause the programme to founder before it is well begun; without goals there can be no sense of direction; impatience in the pace means that action is taken prematurely, and if the pace be laggard, the programme will be outstripped by events.

Your Commissioners are not concerned, within their terms of reference, with the direction or pace of federal programmes for northern development, but are necessarily interested in the administrative arrangements. If organization is designed too much to fit long-term goals or runs in its development too far ahead of events, it will be unsuited to the conditions in which it must work. If, on the other hand, it is related too closely to the here and now, or develops too slowly, it can become itself a brake on progress. In the three chapters that follow, the organization and practices of the several

departments and agencies are considered as a whole, and recommendations are submitted to improve the relationships among them.

Because the Department of Northern Affairs and National Resources has special responsibilities in the North, its organization and relationships with other departments is of particular relevance throughout the report. The responsibilities relating to the second part of its title—"National Resources"—are of interest in the present context only to the extent that they form part of its northern activities. Other aspects of its responsibility for natural resources must be discussed in a wider context, and are therefore left to the final report, *The Organization of the Government of Canada*, which appears in Volume 5.

2

TERRITORIAL ADMINISTRATION

North of the provinces, the geographic basis of administration for matters coming under the Minister of Northern Affairs and National Resources is the territorial division, with a Commissioner as administrative head. At present there are two such divisions: the Yukon Territory and the Northwest Territories. The latter is subdivided into two Districts—Mackenzie and the Arctic, each supervised by a District Administrator. The Commissioner of the Yukon is in Whitehorse, the territorial capital, and the Administrator of the Mackenzie in Fort Smith; the Commissioner of the Northwest Territories (a position held by the Deputy Minister of Northern Affairs and National Resources) and the Administrator of the Arctic are in Ottawa. The creation of a separate Territory of the Mackenzie, under a resident Commissioner, is now planned.

THE YUKON TERRITORY

Even before its acquisition by Canada in 1869, the Yukon Territory was an important outpost of the Hudson's Bay Company, bordering as it did another country—first Russia and after 1866 the United States. In 1898 it was designated a Territory and given a form of local government. The gold rush of that period brought an influx of people, with the result that the Territory had a population of over 27,000 in 1901. Thirty years later it had dwindled to 4,200, but since then it has increased progressively and is now around 14,000.

The present *Yukon Act* of the Parliament of Canada provides for the appointment by the Governor in Council of a Commissioner, to be the chief executive officer of the Territory. There is a Council of seven members, all of them residents of the territories, elected by the territorial communities for a term of three years. The Council sits separately from the Commissioner and presents bills for his assent; any ordinance approved by him may be disallowed by the federal government—the Governor in Council—within two years. Legislative powers of the Commissioner in Council include most matters that are of provincial jurisdiction in the south, including the creation of municipalities, the establishment of courts, the incorporation of companies, and the provision of education, health and social services. Unlike the provincial legislature, however, the territorial Council has no control over undeveloped Crown lands and natural resources, which are reserved as a federal responsibility.

The Commissioner in Council may impose direct taxation within the Territory, and may also—and does—impose a tax on furs shipped from the Territory. There is a statutory Yukon Consolidated Revenue Fund, but no tax may be imposed nor any appropriation made unless first recommended to the Council by message of the Commissioner. The Council may borrow for the purposes of the Fund and may authorize idle balances to be invested, but in each case the consent of the Governor in Council is necessary. The Yukon Territory has been treated as a province for the purpose of tax-rental agreements with the federal government and currently is receiving \$475,000 annually under such an agreement. The Yukon Consolidated Revenue Fund is also credited with “any moneys appropriated by Parliament for the Territory as the Commissioner is authorized to expend by and with the advice of the Council”. Finally, all accounts of the territorial government are subject to audit by the Auditor General of Canada.

As executive head of the Territory, the Commissioner is subject to direction by the Governor in Council and the Minister of Northern Affairs and National Resources, and directs a territorial civil service of about four hundred; the latter are not federal civil servants but are entitled, by federal law, to be brought under the *Public Service Superannuation Act*—a move which is now being made. The Commissioner also holds a federal appointment as Controller of the Yukon, in which capacity he is in direct control of about fifty federal civil servants of the Department of Northern Affairs and National Resources.

THE NORTHWEST TERRITORIES

The present system of government for the Northwest Territories really dates from 1905 when the Provinces of Alberta and Saskatchewan were created.

For legal purposes, the Northwest Territories consist of "all that part of Canada north of the 60th Parallel of the North Latitude, except the portions thereof within the Yukon Territory and the Provinces of Quebec and Newfoundland, and the islands in Hudson Bay, James Bay and Ungava Bay except those islands within the Provinces of Manitoba, Ontario and Quebec."

The chief executive officer is the Commissioner, who is appointed by the Governor in Council and traditionally is the deputy minister of the department responsible for northern administration. Like the Commissioner of the Yukon, he administers under instructions given by the Governor in Council or his minister. In 1905, provision was made for a Council of four. This was increased to six in 1921. Until after World War II, the members were civil servants. The Council now consists of nine members, of whom four are elected for three years by constituencies within the Mackenzie District; the others are appointed during pleasure by the Governor in Council—currently two are federal civil servants, two others are residents of Ottawa and one of Edmonton. The "seat of government" is Ottawa, but the *Northwest Territories Act* requires that the Council meet twice annually with one session at a place in the Territories designated by the Governor in Council.

The powers of the Council are akin to those of the Yukon Council but, unlike the situation in the Yukon, there is no special Consolidated Revenue Fund. Instead, there is a special account in the Consolidated Revenue Fund of Canada to which are credited all territorial revenues and moneys appropriated by Parliament for the purposes of the account. In the fiscal year 1961, charges to the account approximated \$2,750,000. Under a tax rental agreement, the federal government paid \$567,000 to the territorial government in 1961; practically all other federal expenditures in the North were charged directly to parliamentary votes, and consequently neither passed through special account nor were administered by the Commissioner in Council.

In the administration of the Northwest Territories, federal civil servants are used exclusively, except for the administration of liquor ordinances, which is done by territorial civil servants. Thus, federal civil servants must act in a dual capacity, federal and territorial. In Yellowknife, for instance, the Area Administrator, who is the federal mining Recorder and Lands and Forest Officer, is also responsible for the issue of car licences, business licences and game licences, all of which are territorial concerns. However, since the permanent executive head, for both purposes, is the person holding jointly the offices of Deputy Minister and Commissioner, no difficulties of divided loyalties arise.

Within the Mackenzie District, Regional Administrators have been ap-

pointed at Yellowknife and Inuvik; a similar office is provided for at Fort Smith but, pending the creation of a Mackenzie Territory, is occupied by the District Administrator.

As was noted earlier, the absence of any natural administrative centres in the District of the Arctic and the weakness of internal transportation and communication facilities will require, for some time to come, that Ottawa remain the focal point of administration. However, with the proposed division of the present Northwest Territories into two territories, the Department plans the appointment of District Administrators, initially at Churchill and Fro-bisher, with a Commissioner of the Arctic in Ottawa. In anticipation of this move, Regional Administrators have already been established in those communities; their offices will become the District centres. But no transfer of the office of Commissioner for the eastern Districts is contemplated, nor does it seem practical. A third region of the present District of the Arctic embraces that part of Arctic Quebec in which the Department of Northern Affairs has responsibilities among the Eskimo settlements; the regional office is now in Ottawa. Except for a few islands which lie outside provincial boundaries, this region is, however, excluded from the jurisdiction of the territorial council, and the continuing responsibilities of the federal government within the region appear to be uncertain.

In both Districts of the Northwest Territories, the existing organization has a top-heavy appearance. Under the District Administrators are the Regional Administrators already described; and below these again there is a division into Areas, each with its own Area Administrator. Thus, between the Northern Service Officer in the local community and the Commissioner responsible for territorial administration, there appear to be three intervening levels of authority. In fact, however, the present arrangement is in part temporary and in another aspect illusory. As noted, the Regional level merely anticipates the creation of the Mackenzie Territory and the greater devolution of authority over the eastern Arctic from Ottawa; with the accomplishment of these desirable changes, the Regional level of organization will disappear. Moreover, the duties of Area Administrators have been confined to essentially staff functions relating to general administration and financial matters. Consequently, functional direction of the work of Northern Service Officers in the communities will be provided directly from the District Offices.

ADMINISTRATION OF THE TERRITORIES

It is not for your Commissioners to put forward any opinion about the feasibility or timing of provincial status for the territories. But, as long as

territorial status is maintained, and indeed as long as natural resources in the territories are retained as a federal responsibility, it would be irrational to ignore the problems of territorial administration in any review of federal activities in the North. In the Yukon, there is a clear division, at least on paper, between the two, except that the Commissioner and a few of his administrative subordinates have dual responsibilities. In the other territories, it is evident that the establishment of a territorial civil service must be a gradual process and that it must be carefully planned to avoid creating separate positions for fractional jobs. With activities being on so small a scale in the past, it would have been carrying logic too far to distinguish too precisely between federal and territorial responsibilities in terms of officials.

Nevertheless, a continuation of the present system would seriously retard development, for the rigid application of federal standards to jobs in the North is bound to prejudice local recruitment. On the other hand, it is not to be expected that federal civil servants will be prepared to accept territorial status if it means abandoning their federal rights and burning their bridges behind them. There is no necessity to copy the Yukon exactly for the sake of a superficial consistency, provided that some better arrangement can be devised. Early steps should be taken to establish the framework of a territorial civil service for the projected Mackenzie Territory, and the classification and remuneration structure should be based on comparable provincial rather than federal standards, modified to suit northern conditions. Federal civil servants seconded to the territorial service, either temporarily or permanently, should be permitted to retain their status and superannuation rights, any differential cost being borne by the federal government. The application of a similar arrangement to the new eastern territory might be deferred for a few years in order to reap the advantage of experience gained in its implementation in the Mackenzie.

Amalgamation of Indian and Eskimo affairs in the North, as recommended in Chapter 3, will facilitate the integration of Indian education and welfare administration with corresponding elements of the territorial administrations. Much has been done already; there is no segregation in schools, and all child welfare is in the hands of the territorial welfare officers. There is no evident justification for different scales of relief for Indians and their cousins next door, and one Indian Agent of the Department of Citizenship and Immigration said that his responsibilities had by now been reduced to seeing that his Indians were treated no less favourably than their non-Indian neighbours. In the circumstances, proposals to extend the social service activities of the Indian Affairs Branch in the northern territories cannot be justified. Instead, the remaining work of the Indian Agents in the Northwest Territories

and the Yukon Territory should be taken over by the Territorial governments, with suitable reimbursement by the federal government.

We therefore recommend that: Agreements be negotiated with the territorial authorities for the assumption by them of the work of Indian Agents in the Northwest Territories and the Yukon Territory, and the staff of the Indian Affairs Branch be withdrawn from the territories as soon as the necessary arrangements can be put into effect.

One matter that is of provincial concern in the south seems likely, in the foreseeable future, to remain a direct federal responsibility in the territories: the control of undeveloped Crown lands and resources. However, the practice adopted in the Yukon, of appointing the Commissioner of the territory as the federal resources officer, serves to provide unity of direction at the top, and is essential if territorial and federal duties are to be borne jointly by northern officials. It is further suggested, however, that as the territorial public services develop, such joint duties might equally well be assigned to territorial officers, as a means of maintaining full flexibility in the use of personnel—and, incidentally, of developing among territorial staffs the experience as Mining Recorders and Lands and Forest Officers that would be required if, at some future date, control over lands and resources were to be surrendered by the federal government. As long as the Commissioner is held fully accountable, federal interests would be adequately protected. It will be evident from the foregoing that the recommendation in the report on *Real Property*, to the effect that the Department of Public Works be made responsible for the administration of federal lands, is not intended to apply to the undeveloped lands in the territories.

A factor that has hindered the devolution of responsibility to the territories is that the functions normally undertaken by a provincial government are not all under the control of the same federal department. The Department of National Health and Welfare and the Department of Justice are cases in point. In the report on *Health Services*, it is recommended that the health services in each of the territories be placed under a resident senior medical officer. Similarly, in the report on *Legal Services*, it is recommended that a resident legal officer be appointed to fulfil the functions of a provincial Attorney General in each of the territories. Clearly, neither the Department of National Health and Welfare nor the Department of Justice can abdicate its responsibilities overnight. Continuing guidance will be necessary during

the transition period, but the adoption of those recommendations will serve no practical purpose as long as direct control from Ottawa is retained. In each territory, the senior medical officer and the senior legal officer should therefore be directly responsible to and under the authority of the Commissioner.

Historically, the Royal Canadian Mounted Police have had a special connection with the North, where for nearly seventy years they were almost the only full-time representatives of government. A police officer administered the Yukon before the constitution of the Territory in 1898, and the reorganized Northwest Territories were almost exclusively administered by the police for about forty years after 1905. Notwithstanding the development of northern administration by the Department of Northern Affairs and National Resources, direct responsibility for law and order in the North has been retained by the Department of Justice. It is recognized that police services in the territories must be subsidized by the federal government to the extent of the larger part of the cost, but this circumstance does not require the total severance of police responsibility from the territorial administration. It is understood that the transfer of police responsibilities to the territorial authorities is now planned; the proposed appointment by the Department of Justice of legal officers to discharge the duties of territorial Attorneys General under the Commissioners would appear to facilitate this transfer. There would then be no discernible obstacles to the establishment of arrangements similar to those in the contract provinces, modified to suit the special conditions in the North, even if the territorial portion of the total cost has to be met, wholly or largely, by federal subsidy.

From the viewpoint of the many federal departments administering country-wide programmes involving agreements with the provincial governments, the great advantage of the territorial form of northern administration lies in the fact that formal federal-provincial arrangements devised in the south can be applied in the North in the form of agreements with the territorial Commissioners. This includes not only the various forms of co-operation to which reference was made in Volume 3, in the *General Introduction* to the reports on "Services for the Public", but also the federal-provincial fiscal agreements.

The concept of territorial government that has been evolving in recent years offers the great advantage of permitting maximum flexibility in the adjustment of relations between federal and local authorities, from the condition of almost complete federal tutelage in the District of the Arctic to something approaching provincial status in the Yukon. Similarly, it permits the adjustment of administrative machinery to the pace of social, economic

and political development in the northern communities—with progressively greater devolution of authority to territorial centres and progressively greater employment of northern residents in a territorial civil service. If, eventually, the state of development is reached at which provincial status becomes appropriate, one indispensable condition for effective provincial government will exist: a territorial public service experienced in the administration of all matters of provincial concern.

3

INDIAN AND ESKIMO DEVELOPMENT

Two separate departments—the Department of Citizenship and Immigration and the Department of Northern Affairs and National Resources—are now concerned with the education, welfare, and the economic, social and political development of Indians and Eskimos respectively. A third department, National Health and Welfare, administers health services for both groups.

At first glance, the two peoples seem to differ widely in character and geographic distribution. Over ninety per cent of the Indians live in the provinces, and a high proportion of these in the more southerly parts. On the other hand, the Eskimos are concentrated in the Northwest Territories and in the most northerly parts of Manitoba and Quebec. (Those in Labrador remain the responsibility of the Newfoundland Government under the terms of Union, and the federal government is not directly involved in their affairs.) Moreover, many of the Indians in the southern provinces are closely assimilated in their ways, if not in their status, to the populations around them. Among the Eskimos, only those who have been in close contact with the relatively new communities in the Mackenzie basin, or at such points as Churchill and Frobisher, have progressed significantly towards social assimilation, and most of these would still find the customs and attitudes of southern communities strange.

Section 91 of the *British North America Act*, 1867, assigns to the Parliament of Canada the legislative power with respect to "Indians and lands reserved for Indians", and, in 1939, the Supreme Court of Canada decided that, so far as Eskimos living in Quebec were concerned, they were within

the ambit of the phrase. However, for administrative purposes, the *Indian Act* declares that its provisions do not apply "to the race of aborigines commonly referred to as Eskimos". There is no special legislation applicable to these people, but the *Department of Northern Affairs and National Resources Act* places under the Minister of that Department all matters "over which the Parliament of Canada has jurisdiction" relating to Eskimo affairs, excepting those matters assigned to other departments and agencies.

Considered from the viewpoint of administration, however, the problems presented by the two races in the North are indistinguishable. Such variations in administrative needs as may exist are attributable to location rather than to inherent characteristics of the two groups. Throughout the North, both within the provinces and in the Territories, they live in similar conditions, and give rise to identical problems of adaptation and development.

The differences arising out of location are already felt within both the departments concerned. Their effect is most evident in the programmes relating to Indians, where the variation in degree of assimilation is greatest, but the Department of Northern Affairs and National Resources must also distinguish clearly between the problems of Eskimos in the Mackenzie basin and those in the Arctic Islands. The Indian Affairs Branch, as noted in the report on *Education Services*, is pursuing a determined policy of promoting the integration of southern Indians and of using provincial and municipal facilities wherever possible; in the report on *Health Services*, your Commissioners recommended, in effect, that the same policy be adopted in providing medical care. As this is progressively done, the federal government's responsibilities toward the southern Indians will become, in the main, a financial one—with, in some areas, additional concerns arising out of treaty rights and the supervision of reserves and trust funds. Consequently, for both groups the hard core of the task of development, including the direct provision of services, lies in the North.

The close relationship between the responsibilities of the two departments is reflected in the fact that in the third department principally concerned, National Health and Welfare, a single organization administers Indian and Northern Health Services. Equally striking is the manner in which the organization of the Indian Affairs Branch in the Department of Citizenship and Immigration parallels that of the Northern Administration Branch in the Department of Northern Affairs and National Resources, as they existed in 1961:

INDIAN AFFAIRS BRANCH

Administration Division

- Estimates
- Office Services

Agencies Division

- Accommodation and Works
- Transportation and Equipment
- Training and Management

Education Division

- Accommodation and Planning
- Equipment and Special Services
- Guidance and Adult Education
- Practical Arts
- Teachers Registry

Engineering and Construction Division

- Contracts
- Engineering
- Water and Sewage
- Heating and Plumbing
- Architectural
- Electrical
- Structural

Economic Development Division

- Research and Surveys
- Placement and Relocations
- Industrial Development
- Wildlife and Fisheries
- Handicrafts
- Finance and Loans

Welfare Division

- Field Welfare Services
- Public Assistance
- Housing
- Protection and Rehabilitation

Reserves and Trusts Division

- Band Trusts
- Reserves Registry
- Band Membership
- Estates and Land Holdings
- Land Sales and Leases
- Forestry
- Mining

NORTHERN ADMINISTRATION BRANCH

Administration Division

- Finances
- Office Services
- Housing
- Property
- Personnel Services

Education Division

- Schools and Hostels
- Curriculum
- Schools Services
- Vocational Education
- Vocational Training
- Adult Education
- Home Economics
- Industrial Arts

Engineering Division

- Administration
- Planning
- Site Planning
- Mechanical
- Architectural
- Electrical
- Structural

Industrial Division

- Area and Community Planning
- Industrial Promotion
- Co-operatives
- Field Projects
- Handicrafts

Welfare Division

- Family Services
- Linguistic Services
- Community Assistance
- Rehabilitation Services

Territorial Division

- Territorial Council Business
- Vital Statistics
- Municipal Affairs
- Fire Prevention
- Game
- Hospital Insurance
- Labour and Workmens Compensation

Resources Division

- Public Lands
- Lands and Forests
- Mining
- Oil and Gas

It will be noted that, except for the Reserves and Trusts Division of the Indian Affairs Branch, and the Territorial and Resources Divisions of the

Northern Administration Branch, the elements of the two are almost identical.

From the foregoing, it is clear that administrative arrangements relating to Eskimos and Indians should be based on the needs to be met rather than, as at present, on the distinction—in many areas meaningless—between racial groups. When this is done, the natural division becomes essentially geographic. As a first step, in all those northern areas in which the two groups present common problems, the welfare and development of both should be the responsibility of a single Minister.

We therefore recommend that: The responsibilities of the Minister of Citizenship and Immigration relating to Indians in the North be transferred to the Minister of Northern Affairs and National Resources.

Among the most immediate and pressing problems of northern administration are the economic welfare and social security of these scattered and largely indigent primitive peoples, whose numbers increase the more rapidly with every measure taken to protect them against the natural hazards of their environment. Between 1951 and 1961, the Eskimo and Indian population of the Yukon increased from 1,563 to 2,207, and that of the Northwest Territories from 10,660 to 13,233. The Eskimo problem is confined almost entirely to the northern and eastern areas, with overflows into Northern Quebec and Manitoba; there are fewer than fifty Eskimos in the Yukon Territory and relatively few in the Mackenzie basin. Statistics about the Indian population are misleading in considering social aspects, for they refer only to statutory Indians; a substantial number of others are of predominantly Indian ancestry and, in fact, follow the Indian mode of life. As the law relating to Indians now reads, it is possible for the elder children of a married couple to be technically "white" while the younger children are considered to be Indians.

In remote and primitive communities, it is nugatory to draw too fine a distinction between the administration of health, education, vocational training, economic development and social welfare, all of which interlock closely and extend even into the preservation of law and order. Community welfare must take all these factors into account, and successful community development or rehabilitation is possible only if they can be administered integrally. Moreover, any such programmes must take account, in both their planning and execution, of the gulf that separates the native peoples from the administrators—in outlook and temperament—and of the distrust with which the best-intentioned plans may be met. Nor is it enough to distribute benefits

as a form of dole. What is needed is a programme of economic rehabilitation and social development which the local people understand and in which they will co-operate—an object more easily stated than met.

Although outsiders can often analyze local problems more objectively and relate them to broader means of solution and longer time-scales than can the underprivileged themselves, remote control and a cautious paternalism are no substitutes for local enthusiasm and a local sense of responsibility, particularly if the outsiders are of a different culture and speak a different language from the group that is being helped. The planning must be done by persons with first-hand experience of the conditions to be met. And, equally, it must be administered at the point of impact with the community—by administrators with some power to adapt the plan as local circumstances require.

These principles are neither revolutionary nor new. In Canada, remarkable successes have been achieved along these lines among the Eskimos of Labrador by the Grenfell Association and, in recent years, among the Métis and Indians of Manitoba by the community development service of the provincial government. In the administration of the North, they have been adopted unreservedly for only eight years, and the results have only recently begun to appear in the development of co-operatives and other undertakings that provide a greater measure of local self-support.

In those eight years, the development of headquarters staff in the Northern Administration Branch has almost outstripped the pace of growth in the northern field force, reflecting the emphasis on planning. In the Welfare and Industrial Divisions of the Branch, the former with no more than nominal control over welfare activities in the Yukon, there were last year sixty-two positions in Ottawa and only eighty-five in the Northwest Territories. Moreover, your Commissioners have been critical, in their report on *Education Services*, of the disproportionate size of the Education Division headquarters staff of the Northern Administration Branch and of what appears to have been over-elaborate planning. The Department has reported that, in all divisions, the emphasis has now shifted from planning to implementation, with the result that the future growth will occur entirely in the field; in some divisions, a contraction of headquarters is expected.

Your Commissioners wholeheartedly endorse a change in this direction. At the same time, it is urged that there be a shift to the field of authority as well as staff. In the Estimates of the Northern Administration Branch for 1962-1963, provision was made for twenty positions carrying salaries of \$10,000 a year or more in headquarters and only ten such positions in the northern territories. If the shift in emphasis from planning to operations is

to be effective, there must clearly be an upgrading of senior positions in the field, with a corresponding increase in the devolution of authority.

If field officers are to operate effectively in the North, they must work within a general framework of administrative direction that is suited to northern conditions and recognizes the greater need for improvisation. General regulations that may seem appropriate to federal administration in southern Canada may be preposterous in, say, Tuktoyaktuk. The Department does what it can within the limits of authority imposed upon it by legislation or Treasury Board regulation, but local officials lack the authority to use their discretion in, for example, balancing the saving in relief payments against the cost of marginally justifiable undertakings that would make employment, or in the use of obsolete or surplus material and equipment for purposes other than those for which its procurement was authorized. All too often, desirable but not strictly necessary local work could be done at almost negligible cost with local resources of people and material that would otherwise be going to waste but, when authorization is sought from Ottawa, the rigid application of unnecessarily high standards raises the estimated cost so high as to render the whole project unduly extravagant; the results are that the work remains undone and the relief payments continue, to the material and spiritual detriment of the community concerned and no real saving to the taxpayer at large.

We therefore recommend that: Consideration be given to relaxing the restrictive effect of federal regulations in the territories, within appropriate limits, and local officials be given specific direction and the requisite authority to make the best use of local human and material resources.

4

CO-ORDINATION OF FEDERAL ACTIVITIES IN THE NORTH

Northern conditions create special problems for the administration of the general programmes of the federal government. To meet these problems, special arrangements are necessary.

Until comparatively recently, except in the Yukon, the sole federal presence throughout the territories was the Royal Canadian Mounted Police. Now, however, defence programmes have taken the Armed Forces into the North in sizeable numbers; the Marine Services and Air Services of the Department of Transport—including the Meteorological Branch—have established posts as far as the Arctic Islands, as was seen in the report on *Telecommunications*. The Department of Public Works is building and maintaining wharves and dredging channels and harbours; Mines and Technical Surveys conducts the Polar Continental Shelf Project in addition to a wide range of surveying, mapping and charting operations. The National Harbours Board operates the harbour at Churchill, the Northern Transportation Company carries traffic on the Mackenzie, the Northern Canada Power Commission provides electric utility services to mines and settlements. And, as the northern communities spread, the federal services must follow: the Post Office, Unemployment Insurance Commission and National Employment Service, the Northern Services of the Canadian Broadcasting Corporation, to mention but several.

The special conditions that influence northern operations—climatic, geographic, economic, social and political—were identified in the prior chapters and their general effect was noted. For the organization and operat-

ing methods of the federal departments, two consequences stand out: the need for adapting the general standards and practices of administration that prevail throughout the rest of the country to suit northern conditions; and the need for special co-ordinating arrangements, both in Ottawa and among northern units.

GENERAL ADMINISTRATION

The task of adaptation applies to both the general aspects of management that were treated in the first volume and the management of the supporting services considered in the second. In considering, in Chapter 3 of this report, the administration of economic and social development, your Commissioners have recommended the relaxation of general regulations to permit and encourage the most effective use of the limited human and material resources now available in the North. This recommendation is clearly of equal relevance to the northern administration of all federal programmes.

If northern residents and natives are to play a growing role in the northern operations of the federal government, something more than a modification of personnel standards and regulations is necessary. Vocational training is proceeding and general employment opportunities are being enlarged by the development of natural resources and of new applications for local skills or new markets for local products. But there has been little concerted effort to fit the northern inhabitants for the government jobs that are available, as distinct from efforts to create special work for them. In view of the difficulty of recruiting people to work in the North and the high rate of turnover among those recruited, a more positive approach is needed.

Until very recently, any moves in this direction have been inhibited by the absence, through much of the area, of even the most elementary education, and initial efforts have had to be directed to remedying this deficiency. As general education and vocational training have developed, employment officers of the Department of Northern Affairs and National Resources have provided a placement service, seeking out job opportunities for the northern inhabitants among both private and public employers. Apart from its office in Whitehorse, serving the Yukon communities, the National Employment Service has no field units north of the provinces, most of the needs of northern mining and construction operations having, by their nature, to be met in southern centres. In a sense, it must remain the task of the Department of Northern Affairs to develop the northern peoples—by its education and vocational training programmes—to the point where a labour force emerges that is similar in character to that found in the south. As this occurs, and as northern employment opportunities are enlarged through the development of resources, the National

Employment Service can enter the territories to play its normal role.

In 1962, the Department of Northern Affairs established a training programme at Fort Smith to develop clerks and stenographers for its own territorial offices, but as yet no general training for public service employment is available. The Civil Service Commission has no offices north of Edmonton—for either recruiting or training purposes—and it is doubtful that conditions will justify any change in this regard in the foreseeable future. But if a territorial service is to be developed, Northern Affairs will clearly have to enlarge its own programme as circumstances warrant and, as this is done, its programme should be extended to meet a growing part of the needs of other federal departments—until such time in the more distant future as the assumption of this responsibility by the Civil Service Commission may be appropriate.

Although departures from the standards applied elsewhere in Canada may be necessary, uniformity of standards must nonetheless be maintained within the northern regions. From this arises, in part, the need for special co-ordinating arrangements—to ensure that northern allowances and pay scales, entitlement to leave, scales of rationing, housing standards including scales of furniture and household equipment, transportation privileges and the like are uniform among federal employees working under similar conditions. In this regard, it is noted that the Treasury Board has taken an early initiative and a high degree of co-ordination and uniformity of standards has been achieved.

SUPPORTING SERVICES

In the provision of supporting services for federal operations in the North, the general practices dealt with in the second volume of reports must again be modified to suit the special circumstances. In one case—the development of northern telecommunications—a special need was recognized in the relevant report. Your Commissioners have recommended that the Minister of Transport be made responsible for ensuring that the special needs of the various departments are met in a way that provides maximum integration and facilitates the development of a telecommunications network serving the general needs of the North and stimulating its development.

For the other supporting services, the general recommendations submitted in Volume 2 apply equally to the North, but the special conditions of northern operations must be recognized in their application.

In some respects, northern conditions accentuate the need for changes proposed earlier. For example, federal housing in Whitehorse, Fort Smith, Yellowknife and Inuvik is maintained by the Department of Public Works, while the maintenance of office buildings and certain storage buildings in

those centres is the responsibility of the Department of Northern Affairs, with the result that many skills and supplies must be duplicated. Nine departments maintain separate storage facilities in Fort Smith, further subdivided by branches in some cases; the Departments of Public Works, Transport and Northern Affairs all have permanent warehouses containing such common items as paint and standard hardware. In Churchill, vehicles are maintained, with independent facilities and personnel, by the Department of Northern Affairs, the Indian Affairs Branch, the National Harbours Board, the Royal Canadian Mounted Police and each of the three Armed Forces. In the relative isolation of the North it is all the more essential that there be integration in such matters as construction and real property management, supply and materials management, and the pooling of local vehicles or maintenance facilities—as recommended in the earlier reports.

Northern supply and construction are heavily dependent on the existence of strong administrative and engineering bases in the south. Because of the exceptionally brief shipping and building season, timing is of the essence; a delay of several weeks in any part of the supply or construction process can set programmes back for a year—with the only alternative being the use of costly airlifts. To cope with these circumstances, it will clearly be necessary for the two servicing departments most involved—Public Works, and Purchasing and Supply—to make special arrangements for ensuring that northern needs are met. For the Department of Public Works, in particular, this will require, within the design and engineering organization, a strong and distinct component specialized in northern construction, including a supervisory force within the territories.

At the local level, northern conditions may require some modification of the general arrangements proposed in Volume 2. In local purchasing and supply, for example, considerations of convenience and the desirability of encouraging northern commercial development require that local sources be used where possible in the better established northern communities. However, the relative weakness of local commerce would require the proposed Department of Purchasing and Supply to operate under conditions radically different from those familiar to its field staff in the provinces. This suggests that, for the time being, the Minister of Purchasing and Supply should delegate to the Minister of Northern Affairs the local purchasing function within the territories and, with it, the operation of common warehousing facilities. If this were done, it would permit the Department of Northern Affairs to develop small purchasing and supply components within the territorial services. Similar considerations apply to the disposal of surplus supplies in the North, for which the practices followed in the south are inappropriate; in

Fort Smith, for example, a small warehouse is filled with discarded furniture that has been awaiting disposal action for more than six years.

Responsibility for local building maintenance services might, in many localities, be delegated to the Minister of Northern Affairs and National Resources with the same objects in view. It is also noted that, within the Yukon, the territorial Engineering Department now undertakes, under contract, certain engineering work of the Department of Northern Affairs; this organization might well be used for the supervisory tasks of Public Works on the basis of similar arrangements.

CO-ORDINATION OF PROGRAMMES

The crucial importance of co-ordinating northern operations of the various departments and agencies is clearly illustrated by the difficulties of the construction cycle. Unless requirements for building and works are planned sufficiently ahead and close liaison is maintained between the requisitioning department and Public Works, the orderly development of northern operations becomes impossible and costs are pyramided. The same is true of supply requirements, which must be planned well in advance with deliveries to southern ports timed accurately for the annual sealift directed by the Department of Transport.

The same need for co-ordination is evident wherever the northern programmes of one department have a bearing on those of another. For example, at least five departments are engaged in operations on the Mackenzie River: Fisheries, Mines and Technical Surveys, Northern Affairs and National Resources, Public Works and Transport—to which should be added the Northern Transportation Company. In the summer of 1961, the Water Resources Branch of Northern Affairs was taking soundings in reaches being charted at the same time by the Hydrographic Service of Mines and Technical Surveys; meanwhile, Public Works and Transport had no option but to do their own charting in other reaches where dredging and aids to navigation were urgently needed. In part, this situation reflects a maldistribution of functions which would be corrected by recommendations made in the final report on *The Organization of the Government of Canada*. But no reallocation of tasks will eliminate the need for concerting the work of the various departments in the North.

Generally, in these isolated communities, officials of different departments are on good terms and do all they can to help one another within the limits imposed by the directions they receive from Ottawa. But if programmes are not co-ordinated in the planning stage, little can be done in their execution to eliminate absurdities.

Within the various departments, the officers directly concerned with northern operations generally appreciate the realities of northern operations. But, except in the Department of Northern Affairs and the Royal Canadian Mounted Police, too many senior officials have a limited appreciation of both the potentialities of the North and the limitations imposed by the climate, the isolation and the meagre facilities of all kinds that are available. The effect of this is evident in a jealous insistence on autonomy that leads inevitably to a waste of time and public funds.

With the post-war expansion of government operations in the North, the need for co-ordination was formally recognized, almost as soon as it assumed serious proportions, by the establishment in 1947 of the interdepartmental Advisory Committee on Northern Development. The stated task of the Committee is to advise the government on questions of policy relating to civilian and military undertakings in northern Canada, and to provide for the effective co-ordination of all government activities in that area. Since the formation of the Department of Northern Affairs and National Resources in 1953 the Deputy Minister of that Department has been Chairman of the Committee, and the secretariat has been incorporated in the Department.

The achievements of the Advisory Committee have fallen short of the original hope, although there has been some success in limited functional areas through the efforts of active subcommittees. The principal difficulty lies in the fact that the initiative in referring departmental plans to the Committee, in sufficient time to permit full assessment of their relevance to other projected activities and the adjustment of plans where appropriate, rests with the individual departments. Moreover, as its name suggests, the Committee can only advise. The Minister of Northern Affairs and National Resources has, it is true, a statutory responsibility to "co-ordinate" all government activities in the territories; but this carries with it no power to compel compliance with his wishes.

The solution of the problem, as of so many others, is dependent on collective action, with the Treasury Board taking the initiative. The only practical way to achieve coherence in federal activities is by examination of the mutual impact of programmes when they are submitted for approval. In the past, Treasury Board itself has been limited in this role by the weakness of long-term planning, which has meant that proposals relating to northern operations have had too often to be considered precipitately in order that seasonal shipping and construction deadlines might be met. With the adoption of recommendations submitted in the report on *Financial Management*, involving greater emphasis on forward planning, it should become possible for the Treasury Board to make more effective use of the Advisory Committee.

In exceptional cases, where operations are carried on exclusively in the North under a more-or-less autonomous agency, co-ordination can best be achieved by vesting responsibility in the Minister of Northern Affairs and National Resources. This is now done for the Northern Canada Power Commission (which has one plant in Field, B.C., to serve certain national parks, but is otherwise a purely northern undertaking). In the report on *The "Make or Buy" Problem* in Volume 2, your Commissioners noted the possibility that the Northern Transportation Company Limited might well be separated from its parent Crown company, Eldorado Mining and Refining Limited, in recognition of its status as a common carrier in the Mackenzie River system. Whether or not this is done, it is appropriate, in view of the area of its operations and its relevance to the development of the Mackenzie basin, that the company should be answerable to the Minister of Northern Affairs and National Resources.

We therefore recommend that: Ministerial responsibility for the Northern Transportation Company Limited be transferred from the Minister of Trade and Commerce to the Minister of Northern Affairs and National Resources.

CO-ORDINATION IN THE FIELD

For co-ordination in the North itself among the field units administering the various programmes, primary reliance must be placed on the general proposals already put forward in these reports, especially those relating to the supporting services, with such modifications as were suggested early in this chapter. For the rest, it will depend on the good sense of the officers concerned. The analogy between northern administration in Canada and the task of governing colonial areas cannot be carried to the point of vesting in the territorial Commissioners the all-encompassing powers of a colonial governor.

Nevertheless, it is not only natural but proper that the senior resident representatives of the Department of Northern Affairs should feel a general concern with all federal activities in their areas—in view of their general responsibility for the social and economic development of the North. In one respect, it may be appropriate that this general concern of Commissioners—or, in the eastern Arctic, of District Administrators—be recognized by the grant of special powers to intervene in the operations of other federal departments. This relates to the personal conduct of federal public servants in the area.

Service in the North involves peculiar problems of personnel manage-

ment which cannot be ignored. In isolated and remote communities, where a small handful of officials and their families must consort with each other, day in and day out, officially and socially, for long periods without a break, the significance of personality, character, and social attitudes is highly intensified. Many outsiders are ignorant of northern conditions until they arrive, and the serious strain imposed by isolation and totally unfamiliar surroundings often evokes quite unexpected reactions. It is therefore of the highest importance to make every effort to ensure that emotional stability, temperament and character are given due weight in selecting outsiders for northern positions. Since so many departments and agencies have little experience in the North, consideration should be given to the establishment of a panel of senior officers with northern experience, either active or retired, to screen southern candidates for northern positions and advise the department or agency concerned in making a suitable selection.

No screening process, however, can be infallible, and personality problems are bound to be encountered from time to time among public servants in the North. Moreover, the isolation of many northern posts not only contributes to the development of such problems but also intensifies greatly their disruptive effect within the local communities. If serious damage to morale and stability is to be avoided, both among the public servants and within the northern communities in which they live, such situations must be met more promptly than the normal processes of federal personnel administration permit.

In the light of these circumstances, it may be appropriate that each Commissioner have, in addition to his normal powers over territorial civil servants, the power to suspend temporarily any federal government employee in his territory and to require the parent department or agency to withdraw the employee, if the Commissioner considers this necessary. The power of temporary suspension should, in the eastern Arctic, be delegated to the District (at present Regional) Administrators. Being an extraordinary power, its use would clearly be justified only by extraordinary circumstances.

In all other matters involving other federal departments, the senior resident officers of the Department of Northern Affairs must rely on their own powers of persuasion in their dealings with northern officials, and on their access through the Department to the co-ordinating machinery in Ottawa. Only in this way can their general interest in all government activities within the territories be reconciled with the maintenance of departmental channels of authority and responsibility, which, with the one possible exception noted, is no less essential in the northern operations of the federal government than elsewhere in the country.

23 SCIENTIFIC RESEARCH AND DEVELOPMENT

SPECIAL AREAS OF ADMINISTRATION

REPORT 23: SCIENTIFIC
RESEARCH AND
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A number of briefs and submissions bearing on this subject were considered and these are duly recorded in the final volume of your Commissioners' reports.

Your Commissioners, in acknowledging the assistance and advice received, dissociate all those named above from any of the findings and conclusions contained in this report; for these, your Commissioners assume full responsibility.

PART 1

1

INTRODUCTION

The conduct of scientific research and development is today universally recognized as having a profound effect on the development of nations and the well-being of their peoples. The extent and quality of the research effort not only influence the technical capability of the productive segments of the economy and the adequacy of defence mechanisms, but have broad implications for the health and safety of the people and the success of their adaptation to their environments. In any country, the output of highly skilled scientific personnel needed in increasing numbers is conditioned by the quality of continuing programmes of scholarly research in the educational institutions.

As a consequence of the series of dramatic scientific breakthroughs in the past twenty years there has been in Canada, as in all the mature economies of the world, a tremendous expansion in the scale of research activity. From negligible sums prior to World War II, the expenditures of leading nations have risen to over two per cent of their gross national product. In Canada the expenditure of \$250 million in 1959 represented roughly three-quarters of one per cent of the gross national product.

As in the United Kingdom and the United States, the dominant element of this expansion was direct intervention by government, taking the form of massive expenditures for research and development in its own establishments as well as financial assistance to similar activities conducted by industry and elsewhere. The dimensions of this participation are exemplified by the fact that, in terms of annual operating costs, the programmes financed by the Government of Canada account for over three-quarters of the total research expenditures of the nation. The remainder was at the expense of industry, the universities, and provincial research organizations.

2

THE GROWTH OF GOVERNMENT SCIENTIFIC ACTIVITY

The earliest instance of research and development undertaken by the Government of Canada shortly after Confederation is the formation of the Geological Survey, to explore the mineral resources of the country and undertake related scientific studies. Before the turn of the century, the opening of the West had led to the establishment of experimental farms for agricultural investigation. For many years, these and similar activities subsequently undertaken represented a very minor part of the over-all responsibilities of the departments which conducted them. For the most part, the programmes were related to resource development, the improvement of cereal grains, establishing standards and the analysis and testing of materials.

In 1916, the government recognized the growing need for encouragement of scientific research on a broad scale, as a means of stimulating the industrial development of the country. The Honorary Advisory Council for Scientific and Industrial Research, hereafter referred to as the National Research Council, was formed to recommend policies to the government, and to supervise the distribution of research grants to the universities and industry and the establishment of post-graduate scholarships in the sciences.

From 1916 to 1939 there was a slow but steady growth of scientific activity by the government. New programmes initiated by various departments were still on a modest scale, but annual expenditures had reached a total of about \$5 million by the outbreak of World War II. A noteworthy change occurred between 1925-26 and 1930-31 when annual expenditures of the National Research Council increased from \$139,000 to \$550,000 to finance the opera-

tion by the Council itself of a series of laboratories in Ottawa. The Council's annual expenditures, increasing by 1938-39 to \$880,000, thus brought into being a complex of scientific establishments without equal in the country. While grants to universities were continued on an increasing scale, they came to be exceeded (and still are) by the Council's expenditures on the operation of its own laboratories and research enterprises.

The war years, as might be expected, witnessed a substantial upsurge in the scale of government scientific activity. Expenditures increased seven-fold, reaching approximately \$35 million in 1945. The National Research Council served as the government's principal agent in this growth, which reflected the development of nuclear energy and sophisticated armaments. Both of these activities have since separated from the Council, being today largely the concern of independent organizations, Atomic Energy of Canada Limited and the Defence Research Board.

This wartime expansion, impressive as it was, is overshadowed by the explosive growth of government scientific activities in the postwar years. Since 1945, annual expenditures of the federal government have increased from \$35 million to over \$220 million. All scientific agencies of the government, including many new ones, have stepped up their activities, increasing and diversifying very considerably their scientific and development effort. New laboratories have been built, the number of field stations greatly increased, and systems for gathering data extended to all parts of the country. A corresponding growth in the numbers and range of skills of scientific personnel has occurred. The earliest entrants in the field, the Departments of Agriculture and Mines and Technical Surveys, are today each spending in excess of \$25 million annually. Other departments with important programmes include Fisheries, Forestry, National Health and Welfare, Northern Affairs and National Resources, and Transport.

It is worthy of note that almost the entire research activity of the government has been concerned with the physical and biological sciences. Research in the social sciences—anthropology, economics, political science, sociology, history, economic geography, etc.—has benefitted from no more than token federal support. The unbalancing effect on academic organization of concentrating support in the physical and biological sciences, coupled with the increasing demand for social scientists, is a matter of some concern to the universities.

The National Research Council, in common with the other agencies, has continued to grow, in spite of splitting off segments of its work to other bodies, and its current level of expenditure is approximately \$35 million annually. A notable development of the past ten years was the growth in defence

research and development expenditures which, carried on by the Defence Research Board, the Armed Services themselves and the Department of Defence Production, today account for slightly more than one-third of the total research expenditures of the government.

Table 1—RESEARCH AND DEVELOPMENT—OPERATING EXPENDITURES

	1951-52	1961-62 ¹
	(\$000)	(\$000)
<i>Civil Departments</i>		
Agriculture	11,303	25,346
Forestry	3,785	9,563
Fisheries	1,688	6,428
Mines and Technical Surveys	8,802	25,644
Northern Affairs and National Resources	1,345	3,498
National Health and Welfare	1,565	5,694
Transport	158	1,482
Veterans Affairs	287	389
	28,933	78,044
<i>Defence</i>		
Defence Production and Canadian Arsenal ^a	42	11,513
Defence Research Board	14,346	33,271
Armed Services ^a	32,000	32,157
	46,388	76,941
<i>Other Agencies</i>		
National Research Council	11,881	35,614
Atomic Energy of Canada, Ltd.	6,625	29,756
Atomic Energy Control Board	200	700
Other ⁴	170	680
	18,876	66,750
Total⁵	94,197	221,735

¹ Based on estimates made early in 1961.

² Does not include research paid for and included with Armed Services or Defence Research Board.

³ Air Force expenditures in 1951-52 are estimated. In 1952-53 they amounted to \$23,430,000.

⁴ Including Board of Grain Commissioners, Central Mortgage and Housing Corporation, National Film Board and the Post Office. Although discussed in this report, Polymer Corporation Limited and Eldorado Mining and Refining Limited are excluded from these figures.

⁵ Estimated overhead and indirect support costs of two departments are not included. Amounts involved are \$2,400,000 in 1951-52 and \$7,600,000 in 1961-62.

Comprehensive data as to government expenditures over the years on scientific research and development are not available. Your Commissioners,

in the face of this deplorable lack, have had to assemble information from a number of sources. The growth in the past decade is illustrated in some detail in Table 1, showing expenditures made for the operation of the government's own research establishments and as grants-in-aid and scholarships.

Accompanying the more than two-fold increase in federal expenditures for scientific research and development in the past decade has been a considerably smaller proportionate increase in employment of professional scientific and supporting personnel. The total in these categories, excluding seasonal employment, has grown from 10,791 in 1951-52 to 17,915 in 1960-61. The special problems of accommodating this class of specialist personnel within the public service are referred to later.

3

PRESENT RESEARCH AND DEVELOPMENT ACTIVITIES

THE CANADIAN RESEARCH EFFORT

In the year 1959, the latest for which statistics are available, the country's total expenditures for the conduct of research and development (excluding scientific information services, data gathering and scholarships) amounted to slightly more than \$250 million, about three-quarters of one per cent of gross national product. In comparison, the shares of gross national product devoted to this purpose by other leading countries is considerably greater—the United States more than three times as much, the United Kingdom two and a half times

Table 2—RESEARCH AND DEVELOPMENT EXPENDITURES

	Canada – 1959		United Kingdom 1958–59		United States – 1959	
	Millions of dollars	% of GNP	Millions of £ sterling	% of GNP	Millions of dollars	% of GNP
Total Expenditures ¹	251	.72	478	2.11	12,430	2.58
Financed by Government.....	154	.44	320	1.41	8,030	1.67
Performed by Government.....	126	.36	159	.70	1,780	.37
Financed by Industry.....	78	.23	144	.63	4,075	.85
Performed by Industry.....	97	.28	280	1.23	9,438	1.96

¹ Including universities, etcetera.

and Switzerland almost twice as much. There are also significant variations between Canada and other countries in the way these moneys have been spent and in the degree of participation of industry, as shown in Table 2.

In the three countries shown, the research and development financed by industry represents roughly one-third of the total of such expenditures of the nation. However, in terms of the actual conduct of research and development, industry in Canada in 1959 performed 39 per cent of the total compared with 58 per cent and 76 per cent in the United Kingdom and the United States respectively.

GOVERNMENT-FINANCED RESEARCH AND DEVELOPMENT

Turning now to the government-financed programmes in Canada in the year 1961-62, total operating costs amounted to over \$229 million, including overhead. In addition, expenditures for land, buildings and facilities, which have in the past few years been running at between \$30 million and \$40 million, account for approximately \$37 million, bringing the total of capital and operating costs in 1961-62 to \$266 million. In the comments which follow, frequent reference is made to expenditure levels; in all cases these reflect only operating costs.

Figures quoted earlier dealt with the relative parts played by government and industry in the financing and performance of the nation's total research effort. A significant aspect of the government's scientific policies is the extent to which moneys are applied within its own establishments and to support research elsewhere, principally in the universities and industry. In Canada, the "in-house" scientific activities of the government have long claimed the lion's share of funds available. Table 3 demonstrates the dimensions of gov-

Table 3—FEDERAL RESEARCH AND DEVELOPMENT OPERATING EXPENDITURES
BY PRINCIPAL SECTORS IN WHICH PROGRAMMES WERE CONDUCTED

	1952-53		1961-62	
	(\$000)	%	(\$000) (estimates)	%
Federal government laboratories and establishments	81.3	78	181.6	82
Industry	18.9	18	21.7	9½
Universities	4.4	4	17.7	8
Other, mainly provincial establishments2	—	1.2	½
	104.8	100	221.8	100

ernment support of outside research, and it will be observed that in the past decade the disparity has become even more pronounced.

The present federal apparatus for the conduct and financing of research and development embraces three broad groups of activity, with varying organizational forms. Departmental research is carried on by departments and allied boards in furtherance of the objectives of the departments themselves—in most cases related to resource development. Defence research is carried on by the Armed Forces and the Defence Research Board within the Department of National Defence, and by the Department of Defence Production. Research agency activities comprise the operations of separately established boards and corporations in research and development, mostly non-military and existing independently of any department of government.

As a result of differences in origin and organization, significant variation occurs throughout in the quality of direction, conditions of recruitment and remuneration of personnel, and degree of financial autonomy enjoyed by the various members of the government's research family. The resulting lack of consistency in performance and effectiveness which has persisted in the absence of any central policy is a matter for concern.

DEPARTMENTAL RESEARCH

In most of the departments referred to hereunder, research activities, in spite of the growth already described, remain but a minor function in relation to the total tasks of the department. As a result, science has been required to fit into an existing administrative framework not of its choosing, and related types of research are, if only because of their independent origins, often dispersed within the departments and even scattered among them. In Part 2 of this report such problems are reviewed in some detail and certain recommendations offered for their correction. There follows hereunder a brief description of the current activity of each department.

Agriculture

With an annual budget of slightly more than \$25 million the department conducts research into problems of crops, animals, soils and a small group of related subjects. The professional staff exceeds 800, of whom one-half hold Ph.D. degrees; supporting staff and farm labourers each number about 900. The research programme is carried on in separate establishments known as research institutes, regional research stations, laboratories, and experimental farms.

The investigation disclosed that the quality of research is high and the

department has a record of important and tangible contributions to the agricultural community as a result of its research. From the point of view of organization your Commissioners are less satisfied, and Part 2 of this report refers to steps considered necessary to correct an excessive fragmentation of the research programme. In the absence of strong control mechanisms to unify the whole effort and make possible major policy decisions within the department, there was observed a lack of balance in effort applied in the several main fields of research. Thus the relationship of expenditures to the economic interests of the country have become unbalanced, principally through the devotion of a disproportionately low amount of effort to animal research and a preponderance to crops. As an indication of this imbalance, the country's cash income from the sale of principal farm products (1959) is compared hereunder with the research effort of the department.

		<i>Cash Income</i>		<i>Professional Man-Years Devoted to Research (1959)</i>	
		(\$000)	%		%
Crops		914,218	33	604	70
Soils		—	—	112	13
Animals and Animal Products		1,725,202	62	118	14
Other		168,673	5	29	3
		<u>2,808,093</u>	<u>100</u>	<u>863</u>	<u>100</u>

Fisheries

The research activities under this heading are shared by the Fisheries Research Board and the Department of Fisheries and comprise biology, fish culture, fishery technology and oceanography, covering both marine and fresh water fish. Annual operating costs of \$6.4 million, supporting a professional staff of 218, represent about 25% of the total costs of the department (including the Board).

The biological stations are concerned with studies of the life histories and population dynamics of the principal food fishes, fish culture, and new fishing methods. Technological stations do research in preserving and processing fish and by-products and attempt to promote the efficiency of the fishing industry. Oceanography includes the study of biological, chemical, and physical aspects of the marine and fresh water environment of fishes and other important aquatic organisms. Canada's several international fisheries research obligations are generally carried by the Fisheries Research Board.

The work carried out is on the whole of high scientific quality, particularly in oceanography. Here again, as set forth in Part 2 of this report, your Commissioners' recommendations relate to improved organization and the desirability of combining within a single authority all research activities relating directly to Canadian fishing resources.

Forestry

In this new department, formed by severing the Forest Biology Division (entomology and pathology) from the Research Branch of the Department of Agriculture and the Forestry Branch from the Department of Northern Affairs and National Resources, the main emphasis has so far been on research and development of forest resources. Most of the budget is devoted to direct research; the direct research activities employ 308 professional scientists and a supporting staff of 506 (excluding some 360 seasonal employees), in experimental stations, regional laboratories and institutes spread from Victoria, B.C., to Newfoundland.

The department has been so recently formed that it may be premature to comment upon current problems, but it is observed that its establishment represents further fragmentation of a phase of biological research that is common to scientific research and development programmes in the renewable natural resources—agriculture, fisheries and forestry.

There is a lack of balance and consistency in the present organization, largely due to the different origins of the several divisions. The annual budget is divided approximately 50 per cent to forest entomology and pathology, in which the healthier and more stimulating atmosphere is found; 35 per cent covers expenditures of the forest research branch and 15 per cent the forest products research branch. In the latter branches, with insufficient competent scientists to sustain a serious programme, many of the programmes are of an *ad hoc* nature, with particular stress on industrial programmes.

Mines and Technical Surveys

The character of the activities of this department has changed considerably in the past two decades. It is now recognized as being largely scientific in purpose and it is the national centre for research in geological sciences, geography, mining, metallurgy, fuel technology, astronomy, oceanography and many branches of geophysics.

An annual budget, currently over \$25 million, finances research activity in all of the five branches of the department, as well as the independent Polar Continental Shelf Project. Total professional staff numbers about 650 (seasonal employees omitted).

There is considerable variation in the size of the several programmes conducted by the department. The Mines Branch and Geological Survey together employ over 59 per cent of the scientific personnel but account for only 40 per cent of total expenditures on scientific activities. The Dominion Observatories, with a budget of \$1.8 million, and the Polar Continental Shelf Project, spending \$1.6 million, are followed by the small spenders, Geographical Branch, \$.5 million, and Mineral Resources Division, \$.4 million. The balance of the department's research and development expenditures, approximately \$12 million, is represented by research and data-gathering in the Surveys and Mapping Branch. While in this branch true research is very limited in scope, the data-gathering activities provide the foundation of much of the research carried on by other branches.

The department is rapidly becoming one of the main research arms of the government but retains some traces of its non-scientific origins which are particularly noticeable in the Surveys and Mapping Branch, in some units of the Mines Branch, and in the central administrative and information divisions. Relations between scientists and the administrative staff of the department, although greatly improved, still leave something to be desired. The situation requires a more general acceptance of the fact that, while continuing to be responsible for certain important non-scientific activities, the department has also come to possess the attributes and responsibilities of a major scientific establishment.

National Health and Welfare

This Department provides \$5.7 million to support research, mainly in public health and clinical medicine. Grants to universities and other non-government recipients, chiefly through the National Health Research Grants, absorb about \$3.7 million annually, the remaining \$2 million being spent on research carried on within the department by government research staff.

The programmes and grants of this Department represent roughly half the total expenditures of the government in the field of medical research. The subject is considered as a whole in the Commission's report on Health Services.

Northern Affairs and National Resources

The evolution of this Department, created ten years ago from the former Department of Mines and Resources—itself the successor of the long-established Department of the Interior—reflects the ending of federal responsibility for the natural resources of the prairie provinces and the growing awareness of the needs and potential of the North. Excluding forestry research expenditures, which are reported under the new Department of Forestry, research

and development expenditures have doubled in the past ten years.

Four out of the five main branches of the Department have a degree of interest in research but none is concerned exclusively with it. The annual budget, slightly over \$3 million, is spent by the National Museum of Canada (botany, archaeology, zoology and ethnology); the Canadian Wildlife Service (biology, ornithology and mammalogy); the Northern Co-ordination and Research Centre (anthropology, sociology); and the Water Resources Branch (hydrology and data gathering).

The predominantly administrative activities of the Department create an atmosphere inimical to effective research. The lack of scientific leadership at the higher administrative levels and the inability of scientific staff to secure the resources needed for their work prejudice the effective conduct of research activity. Your Commissioners' detailed recommendations in Part 2 of this report reflect their conclusion that all research activity should be transferred from this Department to more appropriate and congenial environments elsewhere in the public service.

Post Office

A modest research programme is conducted by this Department for the purpose of mechanizing letter and parcel sorting, the largest project being the development of electronic sorting. Most of this work is contracted out and expenditures, which reached a peak five years ago of just under \$1 million, have fallen sharply to a current budget of \$132,000.

Transport

In its Meteorological Branch, with headquarters in Toronto, the Department of Transport conducts programmes of research and development relating to climatology, several divisions of meteorology and instrument improvement. Current expenditure of about \$1.5 million is less than ten per cent of the total expenditures of the Branch, and research activities are overshadowed in more ways than one by important operating responsibilities. Facilities and housing arrangements are less than satisfactory and consideration should be given to the suitability of the Department as a location for the meteorological activities as a whole.

DEFENCE RESEARCH

Ten years ago, defence research accounted for about half the total government expenditures on scientific research and development. Today, at an annual level of about \$77 million, the proportion is approximately one-third, which is significantly lower than in some allied countries. In the United King-

dom, for example, research programmes to meet the needs of the Armed Forces represent about three-quarters of all government expenditures on scientific research and development.

The proportion of the total defence budget devoted to research activities in Canada provides another indication of a less intensive approach to defence research than is found elsewhere. Present defence research expenditures in Canada account for but five per cent of the total defence budget, whereas in the United States about twenty per cent of the budget is so applied. A further important disparity exists in the manner in which defence research funds are spent in Canada as compared with the United Kingdom and the United States. While in both the latter countries only 20 per cent of the total is spent on basic and applied research, with the balance devoted to development, Canadian expenditures are divided approximately equally between research and development. As a result of devoting so small a proportion of the defence budget to research and development, coupled with the relatively small allocation to defence development from the limited funds available, the impact of defence activities upon industry has been very much less significant in Canada than in other countries. Thus in Canada defence development expenditures represent .08 per cent of gross national product compared with 1.3 per cent in the United States; on a per capita basis, Canada is spending on development \$1.50 compared with £4 in Great Britain and \$36.00 in the United States of America.

In spite of the several major disparities between defence research and development expenditures in the United Kingdom, United States, and Canada, there is conclusive evidence that some Canadian defence research programmes are making disproportionately high contributions to military science and technology. Substantial progress has been made in Canada in such diverse fields as hypersonic and plasma physics and anti-submarine warfare, upper atmospheric research, blast physics, etcetera, with comparatively small teams. Similar programmes are being pursued abroad with appreciably stronger scientific groups and the Canadian successes are due largely to the enthusiasm of the scientists and to the use of small select groups.

The Canadian programmes cover almost the entire range of the scientific disciplines and extend from bio-sciences and the behavioural sciences on the one hand to the physics of the upper atmosphere and atomic energy on the other. It is not surprising to note that the research and development effort as a whole is spread rather thinly. This condition is not necessarily unsatisfactory, for it is symptomatic of a very high degree of enthusiasm which should not be discouraged. It may also be regarded as a Canadian characteristic; even in the

universities there is a tendency to set targets which stretch resources to the limit—a not unhealthy condition.

The Several Agencies

Upon its formation in 1947, the Defence Research Board took over most of the defence research activities of the National Research Council. In its own establishments, with an annual budget of \$33 million, it conducts defence research and a limited development programme. In contrast, the other agencies in this field undertake development but no research. Herein lies the key problem to the efficient organization and conduct of Canadian applied research and development activities. Applied research and development merge one with the other so intimately in practice that, to maintain a balanced and realistic programme, it is most unwise to separate them.

The Chairman of the Defence Research Board is equivalent in rank to the Deputy Minister of the Department of National Defence and to the Chiefs of Staff, which fact alone exemplifies the importance military science has achieved in Canada. Further, the Chairman of the Defence Research Board is a full member of the Chiefs of Staff Committee, and the Defence Research Board is generally recognized as a fourth arm of the Service, but it is as a fourth arm, rather than as the senior scientific authority of the Department, that the Board operates.

Although a major statutory function of the Board is to act as a defence research policy-advising body, with implied responsibility for the whole of such activities, that duty has never been assumed. Accordingly, the three Armed Services, each with its own development programmes and collectively spending about \$32 million annually thereon, enjoy a great measure of autonomy and are virtually independent of the Defence Research Board. This lack of cohesion has important implications in the field of policy-making, a subject discussed in a later chapter.

The scientific development activities of the three Armed Services, of which the RCAF programme is the largest by a considerable margin, show little evidence of co-ordination. While present Service budgets, \$32 million in total, are approximately equal to that of the Defence Research Board, special weapons programmes, notably the development of the "Arrow" as a manned supersonic interceptor aircraft, raised development expenditures to a peak of nearly \$72 million in 1957-58.

An inherent difficulty in the organization of the Armed Services development efforts arises from the "tour of duty" procedure, under which officers are posted in different parts of the Service for three or four year tours of duty. In defence development programmes, frequent changes of command are not

conducive to efficiency. Sometimes, also, senior officers with limited scientific and engineering background or knowledge are posted to essentially defence development commands, purely on the basis of seniority. The early retirement age of senior uniformed personnel further reduces continuity in programme administration to an undesirable degree.

Active participation by the Services in defence development programmes is an obvious corollary of Service responsibility for defining needs, and for conducting proving and trials programmes and training activities. Today, less than ever, can the "user aspect" be supplied by civilian scientists and engineers. However, as a result of factors mentioned above and the rapid advances in science and technology, it is doubtful whether the Services are adequately staffed, from the standpoint of technological capability, to direct and supervise development programmes in the future. The most practical remedy lies in making the best use of the skilled personnel available by a proper co-ordination of the several agencies involved—a subject discussed later in this report.

Two other agencies are involved in the development side of defence scientific activities. Canadian Arsenals Limited, a Crown corporation engaged in munitions production, conducts development programmes initiated in the Defence Research Board and by the Armed Services, spending about \$1 million annually thereon.

The activity of the Department of Defence Production in this field relates specifically to the development-sharing programme initiated with the United States in 1959. While it is premature to attempt to assess the long-term impact of this programme on the prospects of active participation by Canadian manufacturers in joint United States-Canada defence development and production projects, there is no doubt that an auspicious beginning has been made. Current expenditures are slightly over \$10.5 million and the programme is broadening in scope; the volume already approaches that now contracted out to Canadian industry by the Armed Forces and the Defence Research Board under purely domestic programmes.

The Role of Canadian Industry

By far the most striking fact to emerge from a comparison of defence research expenditures in Canada, the United Kingdom and the United States is the astonishingly small degree to which Canadian industry shares in the programmes. Apart from joint U.S.-Canadian development-sharing projects promoted by the Department of Defence Production, the total of expenditures by way of extramural contracts with industry approximates \$12 million annually, equal to 37 per cent of total defence development expenditures. In the United Kingdom 90 per cent of such work is contracted out and the sums spent with

industry, £175 million per annum, represent an expenditure on a per capita basis of over \$10. In the United States a preponderant share of the \$36 per capita spent on defence development is represented by contracts placed with industry. In comparison, the Canadian extramural costs with industry total but 55 cents on a per capita basis.

Canadian industry's participation in defence research activity is reduced to nominal proportions, compared with its counterparts in the United Kingdom and the United States, not only by the factors referred to earlier—the small proportion of the Canadian defence budget devoted to research and development and the small scale of development effort in comparison with research—but by the conduct on an intramural basis of the greater part of the development work undertaken. The significance of these variations as they affect Canadian industry can be illustrated by pointing out that should defence spending in Canada conform in character to that of the United Kingdom and the United States, the total defence budget of \$1,600 million should support development contracts for industry of between \$150 million and \$250 million.

The economic consequences to Canada are of major importance. A more adequate level of spending with industry would not only beneficially affect employment and tax revenues but, in the light of United Kingdom and United States experience, the resulting stimulation of industry would have lasting and far-reaching implications in terms of the industrial capabilities of the nation. Research and development carried on by manufacturers engaged on defence projects inevitably spill over to improve the technologies applied to production for civilian needs and for export. Canada, by following existing policies in its defence spending, may well be guilty of a costly neglect of opportunity to enhance its industrial skills and capacity.

This state of affairs has developed in the absence of proper policy-making machinery at the centre of government, a topic discussed in a later chapter. There are, however, several specific contributing factors worthy of mention.

Senior officers of the Armed Services display a marked lack of confidence in Canadian science and technology as a whole, manifested by a lack of interest and understanding by the Armed Services in a large part of the Defence Research Board programme. This attitude may stem from certain unhappy experiences, and may also derive in part from the growing need felt for Service self-sufficiency and minimal reliance on outside sources. That this lack of confidence is unwarranted is amply demonstrated by a record of first-rate achievement by Canadian science over the past few years.

Partly on this account, and partly as a result of excessive caution by inter-Service control committees which often amounts to inaction, few of the promising research projects have been carried through development and

prototype stages to eventual production for the Services. This does not reflect on the high standard of work which has been conducted by the Defence Research Board, but rather on the inability of the Armed Services to capitalize on it. This failure to pursue promising defence developments has had serious effects for Canada in the loss of valuable exports, of facilities for advanced technologies, and—more important—of some first-class scientists and engineers to other countries.

As the procurement agency for the Armed Services the Department of Defence Production is a necessary intermediary in arrangements between defence research establishments and manufacturers. While the advantages of interposing a civilian purchasing agency between the parties outweigh the resulting complications, your Commissioners are not satisfied that such complications are minimized, as they should be, by effective procedures and efficient organization.

Implementation of recommendations made in other reports on the future role of the central control agencies will afford a partial solution to this problem, but your Commissioners are of the opinion that there is need for a comprehensive review of existing purchasing, contracting and programming procedures in the interest of greater speed and flexibility.

Organization and Co-ordination

Part 2 of this report contains a description of the present organizational structure for defence research and suggestions for its improvement. The central policy governing the relationships between the several agencies is of transcending importance however, and your Commissioners' findings are discussed hereunder.

While co-ordination of basic research programmes is not important, and indeed is undesirable, some measure of co-ordination of applied research programmes is desirable, and co-ordination of defence development programmes must be regarded as essential. At present five government agencies have an initiating role in development programmes—the Defence Research Board, the Royal Canadian Navy, the Canadian Army, the Royal Canadian Air Force and the Department of Defence Production.

Notwithstanding the fact that the Defence Research Board's applied research programme is spread rather thinly in some areas, the aggregate output of research is impressive, and development programmes in hand, although small in number, show considerable promise. But the Armed Services (and more recently, the Department of Defence Production) are responsible for the bulk of defence development programmes and hence, by implication, for defence engineering. It is in this context that need arises for a careful selection

of projects and for adequate co-ordination of programmes. To achieve optimum results, development programmes may be supported by some basic research but must be closely correlated with applied research programmes.

It therefore appears advisable, in the interests of economy and effectiveness alike, to co-ordinate all defence programmes for applied research and development, including the new "development-sharing" programme, and to provide an effective environment for their conduct. In this area, as in many others, the traditional independence of the three Services gives rise to duplication and waste. Short of total unification of the Services, co-ordinating machinery represents the most likely means of gaining some of the benefits of integration. The urgently needed strength in defence development and engineering should be provided by the creation of a national defence research and development agency—a defence-engineering high command, backed by the resources of the present Defence Research Board establishments, Canadian Arsenals Limited and industry, and supported by the experience of the "development-sharing" groups in the Department of Defence Production.

To assist the new agency, which might appropriately be named the Defence Research and Development Board, and to ensure the optimum utilization of defence scientists, there is need for a strong defence science and engineering planning unit. The growing importance of the "development-sharing" programme requires that the Department of Defence Production be adequately represented. The principal duty of the unit would be to keep the Board adequately informed of defence research and engineering and related programmes in Canada and abroad, and to maintain a continuous assessment of the current potential of Canadian industry to undertake defence research and development.

Under the general direction of the Board, the laboratories, establishments and administrative staff of the existing Defence Research Board should be operated as a common facility available to and working in close partnership with each of the three Services. The actual conduct of development programmes, more an engineering than a scientific task, must remain the responsibility of the Services, but the proposed Defence Research and Development Board, on which each Service should be prominently represented, will play its major role in the planning area by promoting inter-Service co-operation and encouraging the Services to make the most effective use of the laboratories as a scientific facility available to all, with programmes chosen in response to individual requirements.

The role of the Department of Defence Production should remain substantially unchanged. Representation within the proposed defence research and engineering planning unit should ensure proper co-ordination of the "develop-

ment-sharing" programme with the development programme of the Department of National Defence, so that these two different types of demand on Canadian industry do not come into conflict.

- We therefore recommend that:*
- 1 A new agency, to be called the Defence Research and Development Board, be established in place of the present Defence Research Board, to be responsible for all the defence research and development activities presently undertaken in the Department of National Defence.
 - 2 The proposed Board be responsible for advising the Minister of National Defence on all policy matters related to defence research and development.
 - 3 The three Armed Services be prominently represented on the proposed Board.
 - 4 A defence research and engineering planning unit be established under the general direction of the proposed Board.
 - 5 Existing defence research establishments, to be known as National Defence Laboratories, be independently organized under a full-time senior administrative officer, and be operated on behalf of the three Services under the general direction of the proposed Defence Research and Development Board.

RESEARCH AGENCIES

This group of independently established organizations conducts basic and applied research and development in areas not specifically connected with departments of government and, for the most part, unrelated to defence science. In terms of annual operating research and development expenditure, two large agencies, the National Research Council and Atomic Energy of Canada Limited, together account for ninety-eight per cent of the total. Small but important programmes are conducted by operating agencies like Eldorado Mining and Refining Limited, Polymer Corporation Limited and Central Mortgage and Housing Corporation.

National Research Council

Reference has already been made to the founding of this body in 1916 as an advisory council and its embarkation on the active conduct of research in the mid-twenties. As the government's principal arm in scientific matters, it fathered research and development in defence science and atomic energy during the last war and in due course turned over these responsibilities to other bodies.

The Council remains the best known Canadian scientific agency, both at home and abroad, and it has built for itself an enviable reputation for the excellence of its work and the high quality of its professional personnel. Under strong leadership, in the absence of effective national policy-making machinery, it has been the most influential voice in the post-war growth of government science.

Broadly stated the activities of the National Research Council encompass the operation of eleven laboratories or establishments engaged in pure or basic research, applied research, and engineering; it makes grants-in-aid and awards fellowships and scholarships in support of scientific endeavour; it attends to most of Canada's international scientific interests and commitments; and it has responsibility for the newly formed Medical Research Council and Canadian Patents and Development Limited.

Though the range of its interests is broad, the Council does not attempt to cover the whole range of scientific endeavour in its own research and development activities. It does not generally deal with areas of research which are the special concern of government departments. It does not, for example, deal with geology, or mining, or comprehensively with metallurgy. It barely touches the oceans; although actively concerned with outer space, it does little with regard to meteorology; it has few dealings with the social sciences, even those such as anthropology, geography and psychology, which are closely related to the natural sciences.

In addition to its main functions, the National Research Council provides a wide range of supplementary services, including the publication of journals, dissemination of scientific information by various means, and the supervision of a large number of nation-wide technical committees.

The operating budget of the National Research Council currently amounts to \$35.6 million, of which approximately one-third is disbursed as grants and awards (including those of the Medical Research Council). A broad division of current operating costs according to areas of activity is as follows:

Pure (basic research) divisions	\$ 2.7 million
Applied research divisions	4.8 "
Regional laboratories (Halifax and Saskatoon)	1.5 "
Engineering divisions	12.5 "

As of March 31, 1961, staff consisted of 664 scientists and engineers, with supporting staffs of technicians and others numbering 1,819.

The work in the National Research Council laboratories is not assigned on a project basis, the emphasis being put rather on fields of research. The divisions are organized in sections, each of which operates more or less independently in a specified scientific field. The Ottawa laboratories are devoted to investigation in the fields of pure and applied chemistry, pure and applied physics, and applied biology. In Ottawa also, four engineering divisions are concerned with aeronautics, radio and electrical engineering, building research, and mechanical engineering. Regional laboratories at Halifax and Saskatoon slant their investigations toward local resources and economic interests of the Atlantic and Prairie Provinces respectively.

Because the National Research Council was built by scientists for scientists it has become to be regarded by government scientists in all branches as the ideal pattern of a government research agency. A favourable environment is created by freedom from vexatious control in money and staffing and a minimum of close direction of the individual research scientist. By contrast, in government departments, central controls of an absolute nature and non-scientific senior direction prove irksome to professional scientists. Means must be found to overcome this environmental disparity if a uniformly high degree of effectiveness is to be achieved throughout government scientific establishments.

This is not to suggest that scientific workers should be free to pursue their investigations without any direction at all. As indicated elsewhere fundamental research flourishes with minimal supervision of the individual but responsibility must be borne by the director of each scientific establishment for proper programming and the evaluation of priorities.

The governing body, the National Research Council itself, is made up (at the date of this survey) of four of its senior officers, an ex-President, thirteen members from Canadian universities, and one representative each from labour, industry, and a provincial research foundation. This reflects the intent when the National Research Council was established, essentially as an advisory board on national science policy, to make the Council broadly representative of the Canadian scientific community—a character which by reason of the changes since 1916 it can no longer properly claim. In its capacity as a board of directors supervising actual operations costing upward of \$24 million per year, the Council is not appropriately constituted. In fact, its principal concern is with the disbursement of the grants-in-aid and scholarships which represent one-third of the annual expenditures of the organization. Some altera-

tion in the composition of the Council may be appropriate to the new responsibilities recommended later in this report.

Atomic Energy of Canada Limited

Atomic Energy of Canada Limited was incorporated in 1952 to take over the operation of the Chalk River research establishment of the National Research Council. Shortly thereafter the Corporation initiated a nuclear power reactor programme based upon experience with the heavy water natural uranium concept. Experimental reactors at Chalk River and a 20-megawatt nuclear power station at Rolphton have been followed by the construction of a 200-megawatt reactor at Douglas Point, Ontario, which will supply the Ontario Hydro-Electric system. A 40-megawatt reactor in Bombay was presented to India, under the Colombo Plan, for research purposes. Further development in the power reactor field will follow the completion of the Whiteshell Nuclear Research Establishment in Manitoba.

Having regard to the nature of Atomic Energy of Canada Limited, it is difficult to distinguish between research and development, but there is no doubt that the preponderant emphasis in its activities relates to the use of atomic energy in the development of electric power. Approximately twenty per cent of the work carried out in the Chalk River laboratories is devoted to fundamental research in the atomic energy field and the production of radioactive isotopes and source material for Cobalt 60 beam-therapy units.

The annual operating expenditures of Atomic Energy of Canada Limited have increased four-fold in the past ten years to a 1961-62 total of \$29.8 million. Estimates for 1962-63 show a continuation of this upward trend with operating costs forecast at \$32.1 million. Atomic Energy of Canada Limited realizes revenues of over one million dollars annually from commercial sales of isotopes and other products.

Within the past few years there has developed a close and growing relationship between industry and Atomic Energy of Canada Limited. Substantial responsibilities have been assigned to leading electrical manufacturers and nearly \$8 million was provided in 1961-62 for research and development by universities, industrial firms and independent engineers.

The accomplishments of this organization are universally recognized and there can be no doubt that in the successes achieved Canada has received more for each dollar spent in the advance of atomic-energy technology than other leading countries. Concentration of effort in the power-reactor field has been a logical outcome of Canada's early participation in nuclear research. Almost entirely by reason of government leadership and finance, development has proceeded a very considerable distance. The ultimate vindication of these

efforts would be the assumption of initiative by industry and active promotion by it in world markets of the highly competitive product developed as a result of the research to date. Industry has appeared loath to commit itself to the responsibilities involved and it is at least open to question whether such a development can take place so long as Atomic Energy of Canada Limited, in its expanding operations, commands such a degree of leadership and wealth of management know-how.

Other Agencies

The dimensions of the smaller research and development programmes conducted by other agencies, independent of departments of government, are illustrated as follows:

	<i>Operating Expenditures</i>
	(\$000)
Eldorado Mining and Refining Limited (1961)	609
Polymer Corporation Limited (1960)	1,810
Central Mortgage and Housing Corporation (1961-62)	206

The research conducted by both Eldorado Mining and Refining Limited and Polymer Corporation Limited in their own laboratories is of commendable quality. The organization and operating research procedures of Polymer Corporation Limited are recommended as a model for study by industry. The research interests of Central Mortgage and Housing Corporation are entirely served by contracting out—about fifty per cent of the total to the Building Research Division of the National Research Council.

CO-ORDINATION OF GOVERNMENT RESEARCH ACTIVITY

This brief summary of activities in research and development illustrates the breadth of the government's existing interests and the diversity of the programmes financed. Three main divisions of the government spending agencies have been identified—the civil departments, the defence research group, and the independent research agencies.

Although the several units in these divisions are variously organized, there are often close similarities in the work they undertake and in the facilities and techniques employed. All draw on the same pool of university-trained scientists; all look to the government as the principal source of research funds; and, to a greater or lesser extent, all have relations with industries which are dependent on scientific research and development. While in many ways similar

in function, facilities and personnel needs, these diverse government bodies are not subject to any over-all scrutiny or supervision, nor is there available to the Prime Minister and his Cabinet any independent or disinterested adviser qualified to give counsel on their scientific policies or programmes and the priorities which should be accorded.

4

NATIONAL SCIENTIFIC POLICY

Few matters are of more fundamental importance to the peoples of the economically advanced countries of the world than the enunciation of wise and appropriate national scientific policies. What proportion of the nation's resources should be devoted to research and development and how the money available should be distributed to the various areas of scientific investigation are questions the answers to which may profoundly affect the health, the safety and the economic well-being of the nation.

There is no universally accepted pattern for arriving at these vital decisions. In both the United Kingdom and the United States, continuing efforts are being made to devise procedures that will permit top-level decisions to be founded on the judgment of the principal groups involved, including the professional scientists, the universities, the defence forces, industry, agriculture and medicine.

The ultimate responsibility is a heavy one and in a parliamentary democracy must be borne by the government of the day, the Prime Minister and his Cabinet. The fact that political leaders usually possess only a lay knowledge of scientific matters provides no grounds for escaping this onerous task. For good or ill someone must take decisions, and their consequences are so vital and far-reaching that they cannot safely be left to public servants or to any one of the several groups which have a special stake in some part of the scientific spectrum.

A recent President of the United States warned against some of the dangers of specialized influence on the shaping of national scientific policy. He en-

joined his fellow citizens to beware the "conjunction of an immense military establishment and a large arms industry". To this hazard he added "the prospect of domination of the nation's scholars by federal employment" and "the equal and opposite danger that public policy could itself become the captive of a scientific-technological elite". A sub-committee of the United States Senate in June 1961 discussed the problem in the following terms:

The President cannot afford to rely upon any one source of scientific advice. No single scientist, no one group, nor even the scientific community as a whole can be counted upon to foresee the unfolding course of research and technology... Scientists are professional experts... (they) often have strong opinions about the morality or political utility of developments in the laboratory. They are not exempt from the human tendency to allow these beliefs to color their technical judgments, and to become ardent pleaders for special causes. A President needs as much sales resistance in science and technology as anywhere else.

Viewed from where the President sits, scientific counsel is inevitably parochial. It is only one of the many factors he must weigh in arriving at policies covering the full span of our national needs. Measured against the perspectives of the President's office, scientific counsel is therefore like economic and military advice and must in the same sense be subject to civilian control.

In the view of your Commissioners, the existence of suitable machinery for informing and assisting the Prime Minister and Cabinet with respect to major scientific policy decisions is of paramount importance. Such arrangements as exist on paper today are, because of their narrow compass, less than adequate. But the real concern of your Commissioners is that in fact they have been virtually inoperative and the whole post-war expansion of government scientific activity has proceeded on a piecemeal basis without adequate co-ordination. There has been no effective mobilization of advice and counsel from outside the public service and responsibility for the expansion of various activities has been borne by individual ministers without any evidence of their relation to national policy as a whole. It is not unfair to say that the scientific policy of Canada today is the result rather than the cause of growth in the many scientific activities undertaken by government.

CRITERIA IN THE FORMULATION OF POLICIES

The determination of what Canada can afford to spend, or what it cannot afford to refrain from spending, involves consideration of a number of different factors. The selection of the fields of research in which effort is to be applied should take into account the economic needs of the country, its geography (which influences health, resources, and defence needs), its industrial plant and capacity, the skills of its peoples and the educational facilities available for their enhancement; and last, but not least, its international obligations for co-operation in defence and other fields. The degree of effort to be expended in each field calls for the establishment of priorities and a careful

weighing of the claims of each for support against the potential economic and social value of the scientific gains which may result.

Here the questions arising may be of the greatest difficulty. For example, should Canada, in view of its geography, make a major effort to develop long distance transmission of power, or should the money be spent in developing atomic power reactors? Is the challenge of Canada's high rate of infant mortality sufficient to divert research funds from, say, marine biology? Does the expenditure of but five per cent of the research budget on human life and health represent a reasonable apportionment? Of all scientific activities supported by public funds, 82 per cent are conducted within the government's own establishments; is this warrantable, or does it reflect a tendency toward empire-building? Conversely, is the optimum degree of stimulation and support afforded to universities and industry by the expenditure therein of only 8 per cent and $9\frac{1}{2}$ per cent, respectively, of the total scientific budget? These and many other similar questions are the raw material of the decision-making process.

EXISTING MACHINERY FOR POLICY DETERMINATION

The present organization for dealing with high-level decisions in the scientific and research field is composed of two statutory bodies and an advisory panel of senior civil servants.

Privy Council Committee

The Committee of the Privy Council on Scientific and Industrial Research was set up in 1916, under the same statute as the National Research Council, to provide at the highest plane of government a group of Ministers specifically charged with supervision of the nation's scientific research efforts. Broad duties were assigned to it by the *Research Council Act* and later, to a much more limited extent, by the *Atomic Energy Control Act*. The Committee, consisting of ten Ministers, has specific responsibility for the supervision and co-ordination of government research, and for the foundation of broad policies on government research and development expenditures. In 1947 its duties were amended to provide that it should scrutinize all new proposals of a scientific nature before final authorization by the appropriate authorities. This proved unworkable and the Committee now considers only major developments or new projects involving important changes in policy or expenditure.

The National Research Council

This body, formally entitled "The Honorary Advisory Council for Scientific and Industrial Research", is responsible for "advising the (Privy Council)

Committee on questions of scientific and technological methods affecting the expansion of Canadian industries and the utilization of the natural resources of Canada". When formed, the Council was broadly representative of Canada's scientific community, both governmental and private. Today it has a different character, consisting (in March 1962) of thirteen scientists from universities, four senior officers from its own permanent staff, one ex-president and a representative of each of industry, labour, and a provincial research council. The President of the Council is its chief executive officer, in which capacity he administers the laboratories and establishments of the Council. An executive committee consists of three permanent staff members of the Council and at least three others. The President reports on behalf of the Council to the Privy Council Committee.

Advisory Panel

An Advisory Panel for Scientific Policy was set up in 1949 to advise the Privy Council Committee on the formulation and conduct of government scientific policies. It consists of thirteen deputy ministers or deputy heads from departments and agencies having scientific responsibilities, together with the Clerk of the Privy Council and the Secretary of the Treasury Board. The President of the National Research Council is ex-officio the Chairman. This body, clearly non-scientific in character, should possess a fund of knowledge and experience with regard to the managerial problems of science within the government framework and some appreciation of the economic and financial aspects involved.

PRESENT WEAKNESSES

The foregoing pattern would appear to provide a reasonably workman-like approach, although it is subject to objection on the grounds of the poverty of provision for advice from non-government sources, apart from the universities. In practice, however, the system has failed to function as intended. The Privy Council Committee has met infrequently, and between 1950 and 1958 was not called together at all. The National Research Council has turned aside from its original duty of advising on broad national policy and has concentrated its efforts, albeit with conspicuous success, on the support of research and scholarships in the universities and, in a general way, on its own laboratories and establishments and the fields of science in which they operate. The Advisory Panel met formally fourteen times in its first ten years of existence and has since been convened only infrequently. Proposals for new scientific programmes have usually reached Cabinet on the recommendation of individual Ministers, via the Treasury Board, with support provided in some

cases by interdepartmental committees or recommendations from scientific and industrial groups outside the government. The Treasury Board has itself provided the principal review. In these circumstances, new programmes have depended for their adoption on the persuasive powers of Ministers concerned, on the weight of non-departmental support, and at times on an assessment by the permanent staff of the National Research Council.

In view of this evident breakdown of the system as designed, it is remarkable that science in the government has from some points of view flourished as never before. Budgets more than tripled in a decade; there were large increases in staff and facilities; and many new programmes were initiated. Advances in defence research, Canada's active part in the International Geophysical Year, large and expensive new schemes in aeronautics and oceanography, and the reorganization of agricultural research make it apparent that the failure to build on the basis of a cohesive programme has not inhibited the spending of public money.

It is against such a background of disjointed promotion that the Cabinet is called upon to approve plans for expansion of existing agencies and their programmes, or the creation of new ones. Too often, in the existing organizational vacuum, the decision for or against is made in fact by the Treasury Board, largely on the advice of its own staff. These officials, although possessing widely recognized ability, make no claim to scientific competence or foresight.

The missing element of expert appraisal has been compensated for in part by the presence of strong leadership in the National Research Council, the informal participation in policy-making of a succession of able presidents, and frequent consultation amongst scientists on a number of committees. While their contributions have had undoubted value, as part of the operating research group with a direct stake in one segment of it, they have not been wholly disinterested in the elaboration of government scientific policy.

THE REQUIRED STRUCTURE

The principal reasons for the failure of the existing organization to function as intended are, in the view of your Commissioners, three-fold.

- a. The lack of a single Minister having responsibility for guiding Cabinet in the making of policy. A Committee of ten Ministers creates diffusion of responsibility and is hard to assemble, while its members are so concerned with their own departmental responsibilities that the devotion of time and study to scientific proposals must seem to many a formidable distraction. In essence, the Cabinet has lacked a "spark plug".

- b. The lack of a secretariat. To permit adequate consideration of major problems of scientific policy at Cabinet level, a considerable amount of preparation and assembly of information is needed. Even a committee composed of scientists, faced with the choices involved in high scientific policy, would have to be provided with large volumes of background and statistical information dealing with matters not only of scientific but of economic and social significance.
- c. The failure to distinguish between high policy as the embodiment of national aspirations in the whole field of science, and operating or administrative policy concerned with the running of a massive governmental apparatus. Both of these require great skills, discriminating surveillance, and advice from non-government sources, but the approaches are quite different and no common procedures will satisfy both needs.

For these reasons your Commissioners believe the correction of the present situation requires placing senior responsibility for scientific policy on a single Cabinet minister, creating a suitable secretariat to serve this minister and the Cabinet, and drawing a sharp organizational line between the functions of policy-making and the day-to-day operation of the government's laboratories and scientific establishments. While the demarcation of these separate fields must be clear and unequivocal, your Commissioners recognize that adequate two-way communication is essential between those concerned with policy and those engaged in the direction of research activities as such.

The Minister Responsible

The importance of the subject is of sufficient gravity to demand that, if a single minister is to carry the senior responsibility, none other than the Prime Minister should be considered. But, in view of the heavy responsibilities of that office, your Commissioners do not consider that such a course is practicable. The suggestion has frequently been made that a Department of Science should be created, following the precedent in the United Kingdom. This does not commend itself to your Commissioners, because scientific activity, like economic activity, pervades such a large segment of the public service that attempts to centralize scientific activity would impair the effectiveness of the many departments of which today it is an important part.

Whoever is chosen to bear this responsibility must have a specialist staff at his disposal. Moreover, the nature and importance of the function dictates the need for a minister who has a diversity of interests and frequent contacts with departments generally; in short, one who would not be a "special pleader" for some departmental activity.

In its report *A Plan for Management* the Commission recommends the establishment of a new portfolio, the President of the Treasury Board. This office, with responsibility for the general quality of administration in the public service, but without any departmental operating responsibility, seems to your Commissioners the best available choice to carry the responsibility for government science. Both tasks are of major importance and each reinforces the importance and influence of the office and its incumbent.

The Supporting Secretariat

In order to render effective senior supervision at the Cabinet level a secretariat, or Central Scientific Bureau, is required at the centre of government, operating under the direction of the President of the Treasury Board. It should be headed by a competent scientist of broad experience or by a proven administrator literate in science, who should have the status of a deputy minister and be known as the Scientific Secretary. A small but expert staff will be needed, possessing scientific, economic, financial, and statistical skills. Periodic rotation of key personnel with operating branches of government science will have evident advantage in preventing any tendency of the Bureau to become ingrown or static in its approach.

The duties of the Central Scientific Bureau will include the assembly of data and conduct of investigations and studies required in the field of scientific policy. In addition, a general and continuing scrutiny of all government scientific programmes should be maintained, and comprehensive information as to all facets of research and development conducted in Canada and elsewhere should be constantly available. The Central Scientific Bureau, with the aid of External Affairs and the National Research Council, should be responsible for the arrangements necessary to further the international relations of Canadian science. The Bureau should, however, direct no programmes of its own and have neither operating responsibility for nor authority over the conduct of government scientific establishments.

The Advisory Function

In order to mobilize the independent views and advice of knowledgeable groups both within and outside the government, a National Scientific Advisory Council should be established with membership drawn from the several scientific disciplines (in universities, government and outside research organizations), industry (management and labour), the Armed Services and the community at large. Care is needed to secure breadth of representation and freedom from domination by any group, which are essential in a body charged with advising on high policy. The Council will properly include in its mem-

bership prominent scientists in the government's employ and, to avoid embarrassment to them and possible conflict of interest, provision should be made that the Council and its committees should always be presided over, and committees at least fifty per cent manned, by members drawn from outside government service. The Council should be served by the Central Scientific Bureau, and the Scientific Secretary should be the secretary of the Council.

The Council should be called upon each year to review all government scientific programmes. All changes in emphasis or scope should be scrutinized and proposed expenditures as reflected in the Estimates should be considered by the Council before submission to the Treasury Board for approval. A report containing the Council's views and recommendations should be submitted to the President of the Treasury Board following each review. In addition, special meetings of the Council may be required from time to time to consider specific problems or proposals in respect of which policy decisions are urgently required.

- We therefore recommend that:*
- 1 The proposed President of the Treasury Board be designated as the Minister responsible for the scientific policy of the country and the co-ordination of existing activities in the field of research and development.
 - 2 A Central Scientific Bureau be established to act as a science secretariat to the Cabinet under an officer to be known as the Scientific Secretary, reporting to the proposed President of the Treasury Board.
 - 3 A National Scientific Advisory Council be established, with membership drawn from the scientific disciplines, the universities, industry and the community at large, to review and submit independent advice with respect to national scientific policy.
 - 4 The Scientific Secretary act as secretary and the Central Scientific Bureau serve as a secretariat for the National Scientific Advisory Council.

5

THE FUTURE CONDUCT OF RESEARCH ACTIVITIES

A brief description of present research and development activities of each government department and agency has already been given. Part 2 of this report contains a more detailed commentary on existing establishments and recommends certain changes in organization and procedures. Several important considerations emerge, having general application to the organization and management of government research programmes. These, functionally separate and distinct from the policy and decision-making process referred to in the preceding chapter, are discussed hereunder.

ORGANIZATION OF RESEARCH

A notable feature of the growth in government scientific activity is that important research laboratories have evolved from two totally dissimilar origins, namely the departments of government and the National Research Council. There is today little difference in the type of activity in these laboratories but certain organizational inconsistencies persist. Varying degrees of autonomy and an uneven recognition of the need for scientific leadership are causes of dissatisfaction to many government scientists.

In terms of the purpose and objectives of individual programmes and the research areas in which they are carried out, three broad classes are discernible.

- Research in support of, or carried on in association with, the administrative or operational activities of departments; examples are mining, agriculture, forestry and fisheries.
- Research for which the government acknowledges a special interest or responsibility, although unconnected with direct operations; oceanography and astronomy are examples.
- Research unrelated to any specific practical objective but directed towards increasing general scientific knowledge, which may be described as pure basic research.

In order to create an orderly structure in which the various categories of research activity can be accommodated without overlapping or duplication, your Commissioners believe that certain principles should be applied in organizing the conduct of government research. A major consideration is that superficiality be avoided, hence no research activity should be undertaken unless a programme can be developed of sufficient dimensions to permit efficient operation on a continuing basis.

Research falling into the first category above should be gathered together into a research branch or unit attached to the department or agency concerned with the particular area, or at least into the smallest possible number of branches or units, if the area is diverse. These departmental units should be managed by competent administrators with good scientific qualifications and research experience.

Research in the second category, unrelated to any department, should be assembled in a group of national research establishments, each concerned with a particular area of research. Such establishments should operate under a central executive organization, but each should possess a considerable degree of autonomy in the scientific aspects of its operation. Specific proposals for organizational changes to bring this about are made in Part 2 of this report.

Pure basic research, carried out solely in the search for new knowledge, is usually separated according to discipline. In spite of an outstanding contradiction represented by the "pure" laboratories of the National Research Council, it is generally conceded that pure basic research is best done in the universities. Not only is the scholarly atmosphere and academic freedom conducive to scientific investigation, but the conduct of research within educational institutions has an important effect on the training of future scientists. These circumstances lead your Commissioners to the view that in the field of pure basic research government activity should not be increased, and the enlargement of existing, or the creation of new, laboratories of this type should be avoided.

It is generally recognized that the scientific activities commonly described as research and development encompass in any single area of investigation a range of successive types of study. Fundamental or basic research, seeking mainly to expand the frontiers of knowledge, is succeeded by applied research which has as its object the achievement of a particular goal, such as a new process, technique, material or piece of equipment. Development is concerned with bringing forward to the production stage the fruits of applied research; it may involve actual construction of prototypes and be concerned with the perfection of production methods. Thus, the imposing array of new and useful products resulting from scientific advance owe their existence to a sequence of pure or basic research, followed by applied research and, finally, development in industrial plants.

Fundamental research undertaken within an establishment working towards a specific goal, or as part of a programme within a particular scientific area such as agriculture, which may be termed objective basic research, benefits from a feed-back of problems encountered in application and development. Conversely, the latter are extensively dependent on basic research to explain phenomena and to stimulate and suggest new approaches to practical problems. It follows that within a national research establishment the activities may cover the entire spectrum of investigation. In some cases the whole process will be a continuous one where the lines of demarcation between the various types of activity may be difficult to define.

The foregoing considerations applied to either departmental research units or national research establishments, each operating within a specific area of investigation, would render it appropriate in some cases that the research activities should cover the whole spectrum. Thus, it should be permissible for such organizations, when the need exists, to conduct either objective basic research at the one end or actual development to the point of commercial acceptance at the other. Such flexibility is needed if maximum effectiveness is to be achieved.

External contacts of research establishments have a special importance. First, the grouping of activities according to specific areas will facilitate the maintenance of close relations with the industries concerned. General contact and technical liaison should be provided for, in addition to co-operation with respect to programmes designed to assist industry. Secondly, the use of advisory committees to review activities and programmes in each area of research should be part of general policy. Expert independent judgment exercised periodically should serve as a beneficial stimulus as well as a safety

device, and has special relevance where funds are allocated for extra-mural research.

The direction of the scientific investigator and the degree of supervision to be provided present certain difficulties wherever research is conducted on a large scale. In basic research, where a particular subject is chosen for study by the individual scientist in response to his personal interests and curiosity, close supervision is impracticable. Someone must be responsible for seeing that the scientist continues to put forward his best efforts and that a tradition of keen and imaginative application to the task is maintained in each laboratory. But it is virtually impossible, in this field, to parcel out specific work assignments.

In the field of applied research and development, there is not the same case for granting the individual scientist freedom from supervision. In fact, there is abundant evidence that the existing tendency to preserve maximum freedom throughout the whole investigative spectrum has resulted in an inadequate level of supervision, planning and direction, sometimes with costly result. Programmes are in places diverse and thinly spread; others in their goals tend to be "off the target" in terms of the national interest; and, generally, motivation and purpose need to be strengthened by more specific direction and closer supervision. For fear of inhibiting the creativity of the scientists, specific projects in the applied field have been allowed to continue for years after they should have been terminated on practical grounds.

While there is evident need for autonomy in research activity, this cannot justify complete freedom of the staff from supervision and control by senior management. Senior scientific administrators should be given broad responsibility for the selection and direction of their research programmes, but departmental scientific programmes must harmonize with the general aims and purposes of departmental policy. Future planning should, equally, recognize this need.

Like other departmental and agency programmes, research and development programmes will be subject to annual assessment and review by the Treasury Board, assisted by the technical knowledge and experience of the proposed Central Scientific Bureau. To facilitate this assessment, and to provide necessary statistical data, the individual research establishments should accumulate their costs by meaningful sub-divisions of activity, according to the principal components of their programmes. Thus, expenditures for agricultural research should be broken down to show separately the costs of research into animals, soils, crops and other main divisions. In order to provide information required for purposes of policy-making, data similar to

those gathered by your Commissioners should be regularly provided by all research establishments and correlated on an over-all basis by the Central Scientific Bureau.

It has been pointed out that, while there is little distinction between the types of activity in various government laboratories, there is considerable dissimilarity in the administrative and environmental conditions under which research is conducted. The general view of scientists is that the National Research Council's laboratories provide a model environment in terms of facilities, employment and personnel practices, as well as in the degree of financial autonomy enjoyed. Any move towards uniformity throughout the public service should avoid diluting these standards and, rather, seek to establish equally favourable conditions wherever research is carried out. The importance of this subject is such as to prompt your Commissioners to observe that unless the recommendations contained in their report on *Personnel Management* are adopted, so as to grant all departments and agencies suitable authority over their manpower, no change should occur in the existing authority of the National Research Council over recruitment and promotion of scientific personnel.

Although present activity is widely scattered and is remarkably diverse in both its aims and its facilities, some technical needs are common to all units. Scientific information, such as reference services, bibliographies, abstracts and translations; the publication of research results; data processing and the compilation of statistics are illustrations of services generally required which might best be provided for all by a single agency. The development of such common service activity, to be conducted by the most suitable existing agency, should be an early concern of the President of the Treasury Board.

UNIVERSITIES AND OTHER RESEARCH BODIES

Financial support by the government has been a substantial influence in the development of research in Canadian universities. Grants-in-aid, scholarships and fellowships are provided by the National Research Council (to the largest individual amount), the Defence Research Board, the Department of National Health and Welfare, the Atomic Energy Control Board, the Fisheries Research Board, the Geological Survey of Canada, and others. Research contracts, on a relatively small scale, are placed with the universities by Atomic Energy of Canada Limited, the National Museum and the Department of Agriculture. Your Commissioners believe that more can be done, particularly in the exchange of scientists, and that the constantly expanding scope of scientific investigation affords opportunities for wider sharing of research

effort and contracting-out to universities on a substantially greater scale than at present. Some parts of the scientific apparatus of government exist in virtual isolation, not only from other government laboratories but from adjacent universities and other scientific establishments.

This lack of contact may well lead to loss of enthusiasm and a static type of research effort. A frequent manifestation is the use of an increasing proportion of the available funds for intramural activity, at the expense of outside agencies supported through grants, scholarships or contracts. To check these tendencies there should be a general policy requirement that a part of the funds of each agency should be devoted to the support of extramural programmes, and a minimum percentage should be established. Further, particularly in the case of the laboratories and establishments more remote from Ottawa, every effort should be made to create the closest possible links with universities nearby. The existence of a government laboratory staffed with professional scientists on the campus of a provincial university, living to itself with no participation in the academic life of the university, represents a form of waste which should not be tolerated.

In the future planning of research, account must also be taken of other research activities in Canada, in particular the expanding research programmes of provincially-financed bodies. The federal government's responsibility for the country's scientific effort is such that, in planning for the most effective performance in this important field, it cannot, on jurisdictional or other grounds, afford to ignore any substantial activity carried on by others. In this context, the periodic review of programmes by independent advisory groups must have regard to all federal programmes, whether they be conducted in the government's own establishments or contracted out to universities or other bodies, as well as scientific programmes financed from other sources.

RELATIONS WITH INDUSTRY

One of the original purposes of government in devoting money to research was to encourage and stimulate Canadian industry. From being a primary goal this has, over the years, been relegated to being little more than a minor distraction—a desirable but rather difficult task and certainly of less pressing urgency than other items on the programme. So in the year 1961-62 we find a total of just over \$21 million, equivalent to nine and one-half per cent of the total government scientific expenditures, applied to finance research in industry. Of this meagre share, a large part represents business recently secured for industry by the Department of Defence Production under the production-sharing scheme entered into with the United States; and, of the balance, less than

\$400,000 originates with other than the defence agencies and Atomic Energy of Canada Limited.

What are the reasons for this minimal support of industry by government departments and agencies? How sharp is the contrast between Canadian experience and developments in the United Kingdom and the United States?

Some people point to the fact that there are enterprises of magnitude which are not Canadian-owned. Because large industrial enterprises tend to concentrate their research activity in one place, at home, subsidiary plants in Canada are often deprived of opportunity to carry out research in this country and depend on the research efforts of their parent organizations, particularly in the United States. Thus, doubt is cast upon the research capability of Canadian industry. This point of view can certainly be substantiated in some cases, but in the matter of degree there has been a tendency seriously to under-estimate the research potential of the country's industry.

A factor, already referred to, tending substantially to limit the placing of development contracts with industry, is the general lack of confidence displayed by the Armed Forces in Canadian science as a whole, coupled with a possibly inordinate regard for science abroad.

More important, however, than either of the foregoing reasons is the nature of the evolution of the government's own programmes and the attitudes and motivation of its senior scientific personnel. All the factors influencing the "make or buy" decision in government have been present, accentuated by the fact that much of the expansion has represented exploration of new scientific territory in which no outside organization was already established. In the policy vacuum which has existed through most of the period of greatest expansion, industry has had no effective spokesman, and those most responsible for influencing decisions have been persons possessing neither industrial experience nor close knowledge of the operational problems of industrial research.

The National Research Council, originally established to promote research in industry and in universities, has not been successful in its role as a promoter of industrial research. While industry has benefitted considerably from the scientific accomplishments of the National Research Council laboratories, particularly in several special areas, such practical steps as have been taken to encourage the conduct of research by industry itself have been ineffective. For this the rather academic orientation of the National Research Council and its preoccupation with basic research may be in part responsible.

Several new schemes have recently been put forward for assistance to industry in research and development. Your Commissioners entertain serious doubts as to their adequacy in character or scope. Based on the sharing by the

government of the cost of industrial research, they show few signs of any recognition of the hard facts of industrial operation today. A submission received by the Commissioners in June, 1962, from Air Industries Association of Canada, expresses views currently held by much of Canadian industry with regard to development contracts. Your Commissioners find themselves in agreement with the principles set forth:

The Industry considers that one problem in establishing an effective level of government research and development support is the lack of a senior planning policy making group in the government, responsible for establishing national research and development objectives and plans. There are many government agencies familiar with the problem but these agencies lack individual authority for making policy decisions or the responsibility for long range planning and co-ordination of the efforts of all interested government agencies, industry, Armed Services and government laboratories. An analysis of successful past efforts in gaining access to export markets shows that a product must be selected which is advanced but within the present capabilities of the industry. Financial support in the form of research and development funding is then necessary to achieve a competitive product.

What is required to achieve a competitive and healthy aircraft industry in Canada is the creation of an atmosphere favourable to research by the industry. This can only be achieved by a large increase in government support to research and development in the industry with favourable terms and a greatly increased co-ordination between industrial and government research and development planning. The recently announced DRB Applied Research Fund and the NRC Industrial Research Fund is a start but the level of funding is too low to be effective when compared with that of other countries and the required level of industry participation has been firmly set at the unrealistic level of 50%. The industry finds itself in competition with countries which support large development programmes in their aircraft industries and do so at levels up to 100%. At a time when the general level of activity in the industry is diminishing, the government could most effectively provide a stimulus by establishing an effective research planning group in control of a much larger research and development fund. If the increased funds were then released under terms which encouraged a higher level of industrial research the eventual result would be a stronger Canadian Aircraft Industry and one that is capable of realizing a greater share of the world aircraft market.

SENIOR RESPONSIBILITY FOR OPERATIONS

Organizational changes recommended in Part 2 of this report are directed, wherever possible, towards attaching research establishments to the operating department or agency most closely related to the research undertaken. The work of some laboratories and research establishments, however, bears no close relation to any existing department or agency; the largest of these is Atomic Energy of Canada Limited. Although each should have reasonable autonomy with regard to programmes, it would be logical to assign a measure of central administrative authority over these independent agencies to the National Research Council, whose President should have the rank and status of a deputy minister.

The selection of the minister or ministers who are to bear responsibility for the operations of the National Research Council and Atomic Energy of Canada Limited is a matter for governmental decision. Your Commissioners,

however, venture to draw attention to the substantial interest of the Department of Trade and Commerce in scientific development. In view of the relationship of research to domestic economic and industrial activity and to export trade possibilities, there is much to be said for involving the Minister of Trade and Commerce in responsibility for some substantial segment of government scientific operations.

CONCLUSION

In the foregoing discussion, and in the recommendations in Part 2, the central theme is the divorce of the operating organization from the formulation of government policy. The new structure recommended for the latter is not elaborate and is designed to fill the existing vacuum by providing all the pertinent data, backed by the advice and recommendations of independent advisers, as a basis for decisions by the Prime Minister and his Cabinet. Primary responsibility for government scientific policy is placed on a single senior minister, and provision is made for a scientific secretariat without which neither he nor any combination of ministers can effectively discharge this responsibility.

The improvements recommended in the operating organization are mainly changes in emphasis and grouping, together with clarification and simplification of administrative procedures. No major changes in physical plant or facilities are required.

In the matter of co-ordinating activities the creation of the recommended Central Scientific Bureau will fill a present gap. Without authority over any part of the conduct of research, the Bureau will maintain a scrutiny of continuing scientific activities throughout the public service, and will thus be able to render technical aid and informed advice to the Treasury Board in its annual assessment of all scientific programmes of departments and agencies. As a result, for the first time in many years, the scientific activities of the government will be susceptible to review as a whole.

PART 2

1

INTRODUCTION

1 The first part of this report was confined to giving an outline picture of federal research activities, and to discussing research problems and needs in general terms.

2 This part describes in greater detail the research programmes of various departments and agencies, and makes specific suggestions and recommendations based on the findings of the Commission.

3 It should be noted that the size or importance of any department or agency is in no way reflected by the scope or extent of its treatment in this part of the report. Indeed,

several agencies are omitted altogether from discussion: Atomic Energy of Canada Limited and Polymer Corporation, for example, were found by your Commissioners to be well organized and efficient in the performance of their research roles, and for that very reason find no place in this survey.

4 The final sections are devoted to an examination of problems involving all research activities. They include a discussion of the relationship of government research to industry, and of the state of international research liaison.

2

RESEARCH IN GOVERNMENT DEPARTMENTS

AGRICULTURE

1 The Department of Agriculture conducts research in the areas of crops, animals, soils and engineering. The Department's research work also extends to systematics—chiefly insect and plant taxonomy—and includes some entomological projects directed towards insects affecting man. In general, the programme emphasizes the application of science to the problems of agriculture and achieves a satisfactory combination of the agricultural and the scientific points of view. As a result the quality of research is, on the whole, excellent. A great number of scientific papers of high quality is published, and there have been large and very valuable direct benefits to the Canadian economy. These include rust-resistant wheat, the La-combe hog with a high feed-meat conversion ratio, soy bean varieties suitable for Canadian conditions, and measures for the control of insects and disease.

2 The Department has a professional research staff of high quality, whose academic qualifications have markedly increased in the last ten years. These scientists have been

attracted partly by the independent status of the agricultural research officer, who is free, within reasonable limits, to plan and initiate his own projects, and partly by the strongly scientific orientation of the work. The research ranges over basic, applied, testing, and developmental phases. By far the greatest effort is devoted to the applied phase, although some scientists are allowed—or obliged—to continue their efforts on into the development stage.

3 The physical facilities are on the whole good, and the research is not generally hampered by lack of equipment.

4 The present Research Branch of the Department was created in 1959, with the object of co-ordinating the Department's scattered research groups. The reorganization constituted a major step forward; while centralizing administrative and common services, it retained and even extended the freedom of the research units to plan and execute their own research projects. Thus the first stages of implementation were logical steps towards a system of regional research laboratories,

each with a high degree of autonomy. However, once the preliminary reorganization had taken place, the Department appears to have accepted the initial reforms as final. Your Commissioners view this as a failure to obtain the full benefits inherent in the new organization. The present situation may be criticized on several important grounds.

5 First, not all research activities associated with the Department were included in the new Research Branch—for example, the Grain Research Laboratory of the Board of Grain Commissioners. The Animal Diseases Research Institute at Hull, Quebec, with branch laboratories at seven other locations across Canada, is in the Production Branch, although its activities are strongly oriented towards research.

6 Second, the reorganization did not include any major changes in the physical structure of the research programme. There are exceptions to this. Former “divisions” at Ottawa, with their research activities and personnel, were regrouped as “Institutes”, and former Experimental Farm and Science Service units located in the same geographic area were united under a single director. However, this regrouping and consolidation still leaves nine research institutes, and forty-five research stations, laboratories and experimental farms reporting directly to the Director-General of Research. It is this cumbersome arrangement which has necessitated the employment of a Programme Directorate. This committee, comprising four directors (Animals, Crops, Soils, Entomology and Plant Pathology) and fourteen associate directors, has the task of advising the Director-General on the research programme. Clearly, an arrangement by which fifty-four units report to a single office, which is in turn advised by a committee of eighteen Branch scientists, cannot be a satisfactory permanent organization.

7 Third, many small units are still carrying on research in several different areas, classes

and subjects. Lack of sufficient scientific staff in the various disciplines, inadequate research equipment, limited library facilities and insufficient professional contacts make it virtually impossible for such units to develop research programmes of acceptable quality. Productivity, measured either by scientific publications or by agricultural innovations, is much greater in research establishments of reasonable size. The remedy is to take the next major step in reorganization by consolidating small units into regional laboratories where a proper research environment can be created.

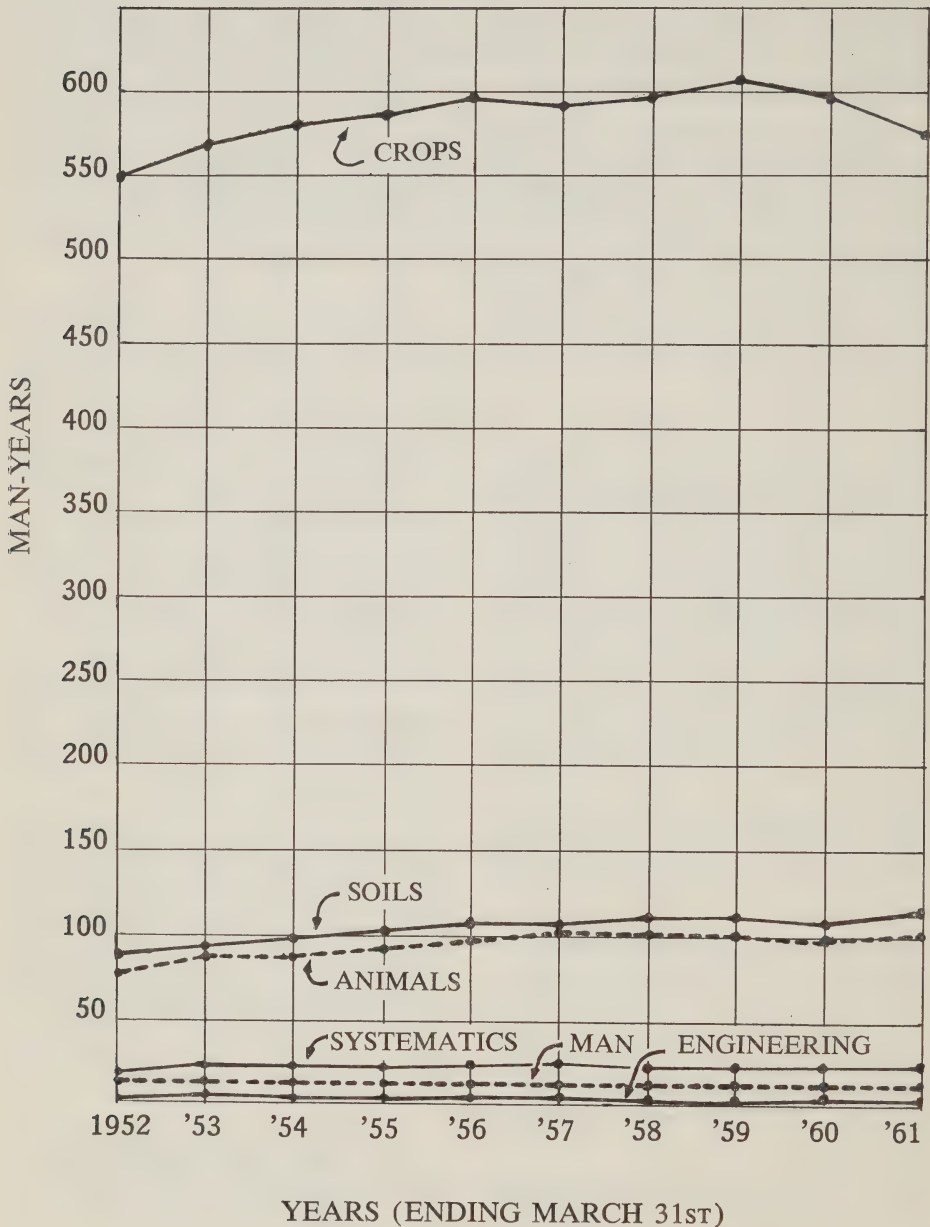
8 Agricultural research is undertaken in response to the needs of an industry and to aid it in efficiently producing marketable goods. Thus, while research projects should be initiated in the laboratory by the professional scientist, who is enthusiastic and close to the problem, the research programme as a whole must take account of the importance of the work in relation to agriculture and to economic factors such as market potential and resource scarcity. Chart 1 shows the present distribution of the number of man-years devoted to areas of research between 1950-51 and 1960-61, inclusive. It will be seen that very great differences exist in the amount of professional effort put into the major research areas.

9 To be effective and economical, Canadian agricultural research requires a well co-ordinated nation-wide organization. It must take into account complex environmental and economic factors extending over a wide geographical area. The paramount aim must be to improve the agricultural industry.

10 *We therefore recommend that:*

- 1 All research supported by the Department of Agriculture be administered by the Research Branch.

Chart 1—RESEARCH BRANCH—DEPARTMENT OF AGRICULTURE—AREAS OF RESEARCH
IN MAN-YEARS



2 Regional laboratories be formed by consolidating present research units; they should be few in number and located in academic and research environments, and should supervise sub-stations and other units designed for applied research and development.

3 A development section be set up to ensure that research results of economic significance are carried to the point of commercial acceptance.

FISHERIES

11 Federal scientific research and development in fisheries is conducted by the Fisheries Research Board, and also by two units of the Department of Fisheries—the Fish Culture Development Branch of the Conservation and Development Service, and the Industrial Development Service.

12 Of these groups the Fisheries Research Board is the largest. It conducts both basic and applied research, with emphasis on the latter, and by means of a broadly based membership gives to fisheries research both scientific and industrial orientation.

13 The Board's research responsibility falls into three broad categories: fishery biology, fishery technology, and oceanography. At its biological stations studies are made of the life histories and population dynamics of the principal food fishes. These studies include fish cultural methods, exploration for unexploited stocks, new fishing methods, marine mammals and marine flora, and the over or under-exploitation of fish stocks. Recommendations based on these studies are made to the Department of Fisheries. The technological stations conduct research into methods of preserving and processing fish, and develop new products and by-products from fishery resources. Oceanography undertaken by the Fisheries Research

Board includes study of biological, chemical and physical aspects of the marine and fresh water environments of fish and other important aquatic organisms. The Board also serves as the research agency for work arising from Canada's membership in six international fisheries commissions.

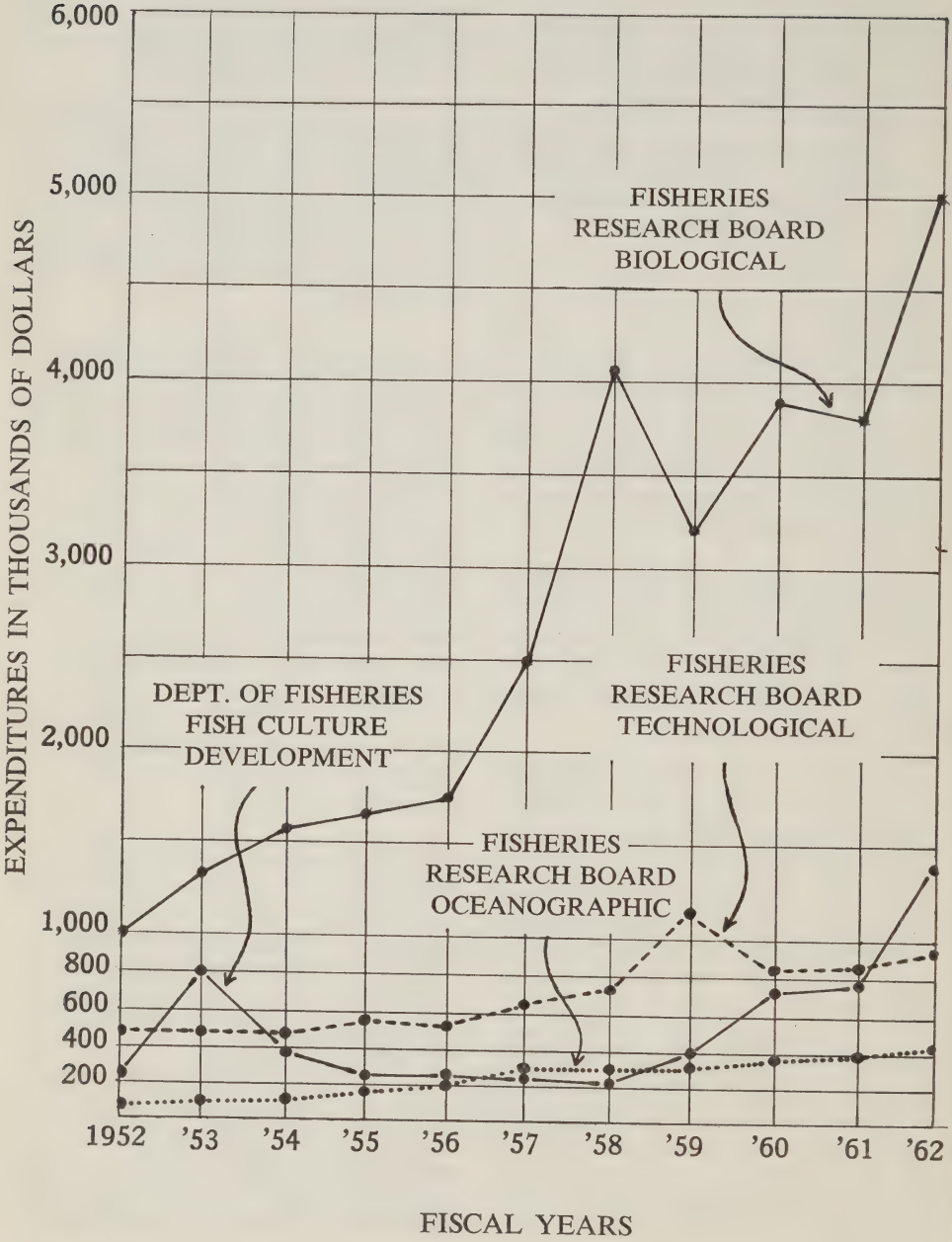
14 The Fish Culture Development Branch of the Department of Fisheries applies modern scientific findings to the problem of maintaining fish populations. The Branch does not undertake long-term research, which is the responsibility of the Fisheries Research Board.

15 The Industrial Development Service has as its primary objective the modernization of the Canadian fishing industry through the application of improved technology in all phases of operations, from the primary catching or harvesting function through the processing, transportation, storage and distributive phases, and the administration of related financial aspects. The Service encourages the fishing industry, provincial fisheries authorities and others to suggest and recommend areas of study and investigation, and to participate as far as is practicable in the developmental projects undertaken. The Service keeps in close touch with the results of fisheries technological developments both at home and abroad.

16 While the scientists in fisheries research have considerable freedom to initiate and conduct research programmes, there is some inconsistency in the allocation of budget funds (Chart 2) and sometimes a tendency to over-emphasize *ad hoc* problems of urgent practical nature at the expense of the long-term research programmes.

17 The wide geographic dispersal of research activities has brought about various organizational problems. Research projects developed in widely separated units of the Department of Fisheries are administered by

Chart 2—DEPARTMENT OF FISHERIES—FISHERIES RESEARCH BOARD



its regional offices. This makes co-ordination of the research programme difficult. Biological and technological units of the Fisheries Research Board are generally not located in the same geographic areas, and, when they are, there is little association or co-ordination of work.

18 Between the chief research groups there appears to be a similar lack of co-ordination in research planning, with little contact and discussion even at senior levels of administration. In many instances the stimulation and advanced knowledge resulting from basic and applied research are not closely co-ordinated by the Department with development and planning for the industry. The Fisheries Research Board is not in close touch with the departmental programme, a distinct disadvantage when planning its own research. There is also a danger that Board members, who serve without remuneration on a part-time basis, may be preoccupied with their private responsibilities and unable to give the research programme of the Board the necessary attention.

19 Some changes are required to develop a co-ordinated and effective research programme to improve the fishing industry, to add to scientific knowledge, and to be in harmony with a national research policy.

20 *We therefore recommend that:*

- 1 The areas of research now assigned to branches of the Department of Fisheries and to the Fisheries Research Board be brought under a single Research Branch of the Department.
- 2 The Fisheries Research Board, renamed the Fisheries Research Advisory Board, assume an advisory role and maintain a continuing scrutiny of all programmes of fishery research.

FORESTRY

21 Forestry research is conducted in three branches of the Department of Forestry: the Forest Research Branch, the Forest Entomology and Pathology Branch, and the Forest Products Research Branch.

22 The Forest Research Branch, with seven district offices and one experimental station, undertakes research into techniques of forest survey (mensuration, statistics, classification), forest management (tree farming, tree breeding), and forest protection (fire fighting). The Forest Entomology and Pathology Branch, with nine regional laboratories and one research institute, does research into techniques for controlling insects, disease and timber decay, and performs nation-wide forest insect and disease surveys. The Forest Products Research Branch is concerned with timber mechanics and engineering, plywood, wood preservatives, wood chemistry and physics, paints and other coatings, and the design of wooden containers.

23 The Department of Forestry has been operational only since 1960, when it was formed by transfer of units from other departments. For this reason no valid judgment can be made on the effectiveness of the new research organization, and your Commissioners restrict themselves to the following observations:

- The establishment of a Department of Forestry fragmented even more the biological research that could be shared in the work on renewable natural resources such as forestry, fisheries and agriculture.
- Research activities within the Department are conducted by three separate branches, each reporting independently to the Deputy Minister. There is little co-ordination of research effort among the three.
- The Forest Entomology and Pathology Branch has a healthy and stimulating

research atmosphere which is absent in the other two branches. A large part of the experimental programme of the latter has been of an *ad hoc* type; when more basic research has been attempted in these branches, a shortage of qualified scientists has reduced effectiveness.

- There is undesirable fragmentation within the Forest Entomology and Pathology Branch. Heads of sections report individually to the Director of the Branch, even when they are located near each other. The entomology and pathology sections are often located in different cities, or in different parts of the same city. Many laboratories are not located at research or academic institutions, with the consequence that scientific staffs are isolated. The separation of Forest Entomology and Pathology from the Research Branch of the Department of Agriculture (of which it was a part until 1960) undoubtedly removed it from access to many of the basic disciplines. If these are not developed within the Branch, the quality of its research may be seriously affected.

MINES AND TECHNICAL SURVEYS

24 The Department originally consisted largely of agencies that had regulatory responsibilities (for explosives, legal surveys, official time service, et cetera) and performed technical services, such as testing of ores and metals, and the preparation of topographical and geological maps and hydrographic charts based on official surveys. Its character has changed rapidly in the last two decades, and it is now one of the main research arms of the government.

25 There are five branches in the Department: Geographical, Geological Survey, Mines, Dominion Observatories, and Surveys and Mapping. The Dominion Observatories Branch is reviewed in another section of this report.

Geographical Branch

26 The immediate research programme of the Branch includes physical and socio-economic geography. Physical geography is divided into regional analysis and quantitative analysis. In northern Canada, this involves terrain analysis (physiography) and glaciology, and some of the work is carried out in collaboration with the Polar Continental Shelf Project. Socio-economic geography consists of regional analysis, land use, and urban studies. The pioneering work of the Branch on land-use is beginning to bear fruit in the programmes developed by the Department of Agriculture under the *Agricultural Rehabilitation and Development Act*. While the urban studies ceased in 1961, the basic studies of urban morphology are of continuing value to other interested bodies.

27 The Branch was largely responsible for the publication of a new Atlas of Canada and this, involving much original research, is a continuing responsibility. The Atlas has won world recognition as the best of its kind, and is the sort of undertaking that fits well into the Branch's formal responsibilities.

28 Research on the origin and distribution of sea ice is an important item both in the Branch's co-operative programme with the Polar Continental Shelf Project and in its normal activities. For more than a decade this work has proved to be of economic importance in the Gulf of St. Lawrence and may eventually be so in the Arctic. This matter is referred to at greater length in Chapter 6.

29 In 1961, the Branch was given responsibility for servicing the Canadian Permanent Committee on Geographical Names. The staff transferred to the Branch for the purpose are not professionally trained, and there is a risk that such accretions will dilute the research flavour of the organization.

30 The Geographical Branch was established in 1947 as the Geographical Bureau, with the aim of reviving federal interest in geographical research. Initiating a new agency in government is never easy; building it up to a size required for efficient operation is even harder. The Branch is still a small organization and has had exceptional difficulty in attracting and retaining personnel of the requisite quality.

31 The Branch suffers from two circumstances peculiar to geography in Canada: first, university departments have been opened at a remarkable rate in the past decade and have attracted most of the best qualified geographers; and second, high schools are now offering attractive positions to geographers with M.A. degree (the minimum qualification acceptable in the Branch) at salaries greatly in excess of those offered by the government. Thus the Branch finds it hard to compete for the small number of good geographers available.

32 The Branch has endeavoured to overcome its difficulty in building up an adequate professional staff by appointing a relatively large proportion of seasonal employees. These numbered fifty in 1961-62, in comparison with a permanent research staff of thirty. Practically all of those seasonally employed are recruited from universities, being either staff members or students. There is merit in this arrangement since it assists the Branch with its seasonal field programmes, particularly in the north, and also enables university personnel to obtain field experience. The Branch could be of further assistance to the universities by expanding its programme of grants-in-aid; the present allocation of \$3,000 for this purpose could be substantially increased.

33 This, together with an immediate review of salary scales on a realistic basis, should go far to solving the Branch's manpower difficulties. There are signs that an increasing

emphasis laid on geography by industry, planning, universities and high schools will soon begin to increase the number of qualified geographers available. The Branch should take steps to attract them.

34 In summary, the Branch was established with terms of reference calling for the development of a programme of high scientific content requiring original research by professionally qualified personnel. It has suffered certain vicissitudes in the form of staffing difficulties, leadership which has not always been sufficiently objective, and responsibility for certain non-scientific tasks which dilute the professional flavour of the organization. It has, nonetheless, achieved a considerable degree of success in certain of its activities. In view of the increasing importance of its work as part of the whole scientific programme of the government, every effort should be made to overcome existing deficiencies.

Geological Survey

35 The Geological Survey of Canada has long been the most active in field mapping. Emphasis continues to be laid on reconnaissance mapping, which is an essential first step in understanding the geological configuration of the country. In addition, field parties are employed in geophysical, geochemical and water supply studies, and in palaeontology, mineralogy and stratigraphy. The effort put into laboratory work has recently increased, while there has been a gradual reduction in scientific manpower devoted to field mapping.

36 One division of the Branch is organized on a regional basis and includes specialists on various areas of the country. The other four divisions are topical: that is to say, they are arranged not by areas but by the subject matter of the research undertaken. These are Fuels and Stratigraphy, Economic Geology, Petrological Sciences, and Geo-

physics. It is from these divisions that the initiative comes in formulating research programmes.

37 A systematic record is kept of all research projects, the date of their completion, and the resultant publications. One consequence is that all research projects are subject to continuous review and the activities of all staff members are known to all others.

38 At one time the Geological Survey was completely autonomous. There are signs that the proper desire to maintain an efficient and progressive organization may lead the Branch to becoming too self-contained. Some overlapping may be expected, which is not harmful unless it leads to competition for scarce personnel or to duplication of expensive facilities. There is a danger of this becoming significant in the Geological Survey Branch, which now maintains an independent library, separate map drafting facilities and increasingly elaborate chemical laboratories.

39 The Survey is an efficient organization, well staffed, with high scientific standards and an excellent national and international reputation. It has expanded rapidly and will no doubt continue to do so, particularly in areas related to geological field work. This is proper, but care must be taken not to duplicate or overlap the work of other existing government facilities.

40 Field work in remote areas of Canada can often be carried out most economically by pooling the resources of several agencies. There is a tendency for the Geological Survey to be unco-operative in such proposals, and to carry through its own plans by use of its own logistics and its own staff. It is in the common interest that the Survey Branch participate actively in co-operative field enterprises.

Mines Branch

41 The main purposes of the Mines Branch are to develop new and improved methods of processing ores, industrial minerals and fuels, and to seek new uses for Canadian minerals and metals. In recent years there has been a growing tendency to concentrate on basic and long-term research, which reflects a general trend throughout the Department.

42 It is not necessary to record in detail the extremely diverse programme of research carried on by the Branch's many laboratories and workshops. As of midsummer, 1961, the number of projects in hand was as follows:

<i>Division</i>	<i>Number of Projects</i>
Mineral Services.....	50
Physical Metallurgy.....	92
Fuels and Mining Practice.....	42
Mineral Processing Division.....	105
Extraction Metallurgy.....	43
Others.....	6

43 The Branch enjoys close relations with the mining industry and other industries in the area of its specializations. This is all to the good, but the Branch should not be considered as a source of free services where commercial research agencies are available. Were the Branch relieved of some of this work for industry, the staff would be freed for more fundamental studies of value to the country as a whole.

44 In contrast to the Geological Survey—with which parallels can fairly be drawn—the Mines Branch is not actively developing in the range and scope of its interests. The general pattern of its operations was set many years ago, yet some of its areas of interest are at the forefront of modern industrial innovation.

45 This lack of development may have been caused by undue emphasis given to more or less routine testing and problem-solving, or it may be an inherent difficulty faced else-

where by engineers rather than scientists. Whatever the cause, the work of the Mines Branch is sufficiently important to the national welfare that the effort should be to meet the demands of the modern age.

Surveys and Mapping

46 Most of the duties of this Branch relate to data-gathering and publications. The work forms the basis for field and other research by other branches of the Department and, in many cases, by other departments and independent scientists. However, research and development, in the narrower sense, are also part of the Branch's responsibility.

47 To understand the significance of any research done in surveying and mapping, it should be borne in mind that Canadian universities have for the most part neglected modern aspects of the science. Only one has a small department of surveying, and it is a recent innovation. None offers advanced instruction in cartography.

48 In the Surveys and Mapping Branch research is beginning. New techniques are being developed for processing survey data, and the Department's computer centre is proving useful. The Branch is aware, too, of the need to be in the forefront of developing new methods of survey, and has pioneered the use of new devices such as Shoran, the tellurometer, and the geodimeter, though it did not originate them. Even so, the best survey methods used today are time-consuming and costly; therefore new techniques are needed in the drafting, compilation and reproduction of maps. For research into these areas considerable expenditure is necessary. Yet no large sums are devoted to it, and there are no Canadian government research agreements, either with the universities or industry, to foster study of the problems concerned.

49 The pressure of demand is forcing changes but they are coming too slowly. A

programme of research and development within the Branch is called for, and a research unit should be attached to the Director's office. This will entail the employment of professional staff with advanced degrees, which should influence the development of higher academic qualifications throughout the Branch. Research in the universities should be supported. A summer student programme should be established to encourage new members to enter the profession and the Branch. More help should be sought from private industry. There is in Canada a useful surveying industry which, partly owing to contract awards by the government, enjoys world-wide repute, particularly in photomapping. The industry is not at present in a position to give leadership in development through research, but could do so with contractual aid from the government. Canada has an opening for a small map-making and printing industry, but this too would need to be founded on research which the industry cannot at present provide.

General Conclusions

50 In spite of its growing preoccupation with research, the Department of Mines and Technical Surveys retains more than a trace of its non-scientific origins. This is noticeable in the Surveys and Mapping Branch, in some units of the Mines Branch, and particularly in the central services such as departmental administration, personnel, and the Editorial and Information Division. However, the whole Department now appears to realize that research is its main function and other activities must be subordinated to it. The objective of any administrative reforms should be purely and simply to increase the effectiveness of the research agencies and give them the maximum autonomy consistent with economy and the general welfare.

51 Consideration should be given to the co-ordinating responsibilities of a department engaging in widely dispersed research activi-

ties. Major facilities that could serve in common, such as libraries, data-processing units and workshops, should be shared, and the Department, taking account of the high costs of field programmes, should ensure that where possible these programmes are arranged on a co-operative basis by several branches and even with other departments. The Polar Continental Shelf project is an example of such co-operation, and is discussed elsewhere in this report.

NORTHERN AFFAIRS AND NATIONAL RESOURCES

52 This Department was formed about a decade ago from units of the large and complex Department of Mines and Resources. In its relatively short life, the northern responsibilities have been expanded rapidly and now overshadow those grouped under National Resources.

53 Of the five branches or equivalent units within the Department, all but one have a degree of interest in research, though none is wholly concerned with it. Discussed in some detail hereunder are the National Museum, the Wildlife Service of the National Parks Branch, and the Water Resources Branch. The Northern Administration Branch has a different function—that of caring for the Yukon and Northwest Territories. While it has depended on scientists from other departments for much of the intensive study of the north, it is now adding some research specialists to its own staff. Because of its implications for several government departments, northern research is discussed in a separate chapter.

Canadian Wildlife Service

54 Mammalogy and ornithology are the main research fields of the Service, with a small amount in limnology. The work is based in Ottawa, at various stations across southern Canada, and at several sites in the north. Field studies are carried on, usually

in summer but to a lesser extent throughout the rest of the year.

55 Many of the research centres outside Ottawa are associated with universities. Close university ties are particularly necessary because academic training in wildlife biology is rare in Canada, so much so that the biologists needed by the Service are increasingly being recruited in the United States. There is little direct aid to universities through grants or research contracts, but use of student help in the summer provides some indirect assistance.

56 The Wildlife Service is a subdivision of the National Parks Branch but, while it provides some services in the National Parks, its responsibilities are nation-wide. At present, it is a small unit with a budget representing less than one per cent of the departmental total. It is a well-qualified, closely knit, active professional group, but is handicapped by being administratively part of a non-scientific branch of a department that is not primarily a research agency. The Wildlife Service and the Zoology section of the National Museum would form a logical unit, which would be more appropriately situated in an atmosphere congenial to scientific research and in a department with field and related activities throughout Canada.

57 *We therefore recommend that:*

The Wildlife Service, with the addition of the Zoology unit from the National Museum, be transferred to the Department of Fisheries.

National Museum of Canada

58 The purpose for which the Museum is maintained has been officially stated as follows:

The main function of the National Museum of Canada is the dissemination of knowledge con-

cerning the natural history and human history of Canada. The Museum sends field parties each summer to collect material pertaining to the prehistory of Man in Canada, the cultures of aboriginal and immigrant races in Canada, and the animal and plant life in Canada, both living and prehistoric. On the basis of this material, scientific reports and popular accounts are written and museum exhibits are prepared.

59 The National Museum has a scientific staff of thirty-eight, of whom twenty-three are professionally trained. The proportion of support staff to scientific staff is low. There are sections specializing in botany, zoology, archaeology, and ethnology, with smaller units concerned with linguistics, folklore and musicology. There is a division into Natural History and Human History Branches, but this has little significance in practice.

60 The link between the scientific staff and the exhibitional-educational activities of the Museum is tenuous, and becoming more and more so. In fact, despite the implication in the quotation above, the scientists do not exist to contribute to the Museum exhibits, and most of them prefer to have no responsibility for them. Some types of exhibit are related to fields of science or human history not represented in the scientific staff. Technical advice concerning them is secured from other government departments active elsewhere. For one field (Botany) in which the Museum is scientifically active, the exhibit was prepared under the guidance of another department (Agriculture).

61 The scientific staff traditionally spend the summer season in the field and the rest of the year preparing reports, for eventual publication, although this system appears to be breaking down. In some cases they also have responsibility as curators for maintaining 'national' scientific collections in such fields as botany, archaeology and ethnology.

62 If a museum is to be more than a mere repository of objects of interest, it must have close ties with research related to its exhibits,

but this does not imply that it must necessarily undertake the research itself. Under present arrangements, the small group of scientists at the National Museum tend to be cut off from the main stream of research in their respective disciplines and have limited scientific facilities. The scientific sections now gain nothing from being nominally associated with the exhibitions, to which they make few contributions of material or advice, and would be better placed in more congenial environments. For example, the Zoology Section should, as recommended, be associated with the Canadian Wildlife Service; and the Botany Section and the National Herbarium could be attached to the appropriate research institute of the Department of Agriculture.

63 Other sections have less obvious ties to particular government agencies, and their role should be to supply a national focus for the fruits of independent research in these subjects by universities and other non-government bodies. Indeed, the National Museum should itself be regarded in this light, and there is no doubt that the educational-exhibitional function would be strengthened by divorcing it from active research and reinforcing its ties with the relevant disciplines both inside and outside the government. In this central role, it would be inappropriate for the National Museum to be a branch of a government department. It could more appropriately be given some degree of independence, within the limits imposed by the provision of funds, under a Director General reporting immediately to a minister—a change that has been under consideration in the Department of Northern Affairs and National Resources.

Water Resources Branch

64 Research and development undertaken by the Branch include data collecting (flows and levels, sediment, evaporation, snow depth and water content, glacier ablations,

et cetera); the study or application of these (determination of hydraulic conditions and of hydraulic features, hydrometeorological aspects, and all phases of water conservation and control); and studies related to matters such as water conservation legislation, water power legislation, international river legislation, and an inventory of water power resources. The systematic hydrometric survey of Canada is the Branch's main responsibility. Extension of it to more remote areas and the demand for a greater variety of data have led to a steady expansion in the programme.

65 Snow surveys and observation of glaciers are undertaken to estimate in advance the water flow in certain rivers. The growing anxiety over flood damage in densely settled river valleys calls for new forecasting techniques and studies to obviate flooding. The continuous regulation of water levels in the Great Lakes is an important duty of the Branch, in collaboration with United States agencies. The earlier concentration on simple recording of data is passing—although this activity must continue and even expand. This trend compels the Branch to be more active in scientific research and development, and it faces urgent demands from many sources to expand and to put increased emphasis on fundamental studies.

66 In 1961 research and development occupied a staff of eighty-seven graduate engineers (eighty-six in 1951), one hundred and fifty-seven supporting personnel (one hundred and fifty in 1951) and eleven seasonal employees. This uniformity in numbers over a decade is in remarkable contrast to other research agencies. Almost all the professional staff are graduate civil engineers, but it was noted that only five have advanced degrees (Master's in hydraulics).

Water Resource Study in Other Agencies

67 To understand the present state of water resource study in Canada, it must be noted

that the Water Resources Branch is far from being alone in the field. Jurisdiction is tenuous in some cases, and it is obvious that local authorities and the provinces have a large measure of direct or indirect interest in water resources. There is also some joint Canadian-United States responsibility. While there is widespread recognition of the need for greater research into water use, confusion exists as to the authority of the various levels of government to act.

68 There is no clear-cut responsibility for water resource study even within the federal government. For example:

- The National Parks Branch controls all aspects of waters within Park boundaries.
- The Territorial Governments control water used in placer mining.
- The Department of Agriculture is responsible for the Prairie Farms Rehabilitation Administration (now developing large irrigation and reclamation projects in western Canada) and the Maritime Marshland Rehabilitation Administration.
- The Department of Mines and Technical Surveys is active both in collecting data and in water management; the Geological Survey is concerned with ground-water studies, and the Surveys and Mapping Branch produces and distributes navigation charts, conducts tidal surveys and operates water level gauges on certain lakes.
- The Departments of Public Works and Transport are responsible for marine structures and aids to navigation, and have representation on various international Boards of Control.
- The Department of Transport is increasingly active—through responsibility for navigation—in icebreaking, maintaining the St. Lawrence ship channel, and in the supervision of canals. Its Meteorological

Branch is in charge of data gathering on precipitation and evaporation and for related research in connection with flood control, et cetera.

- The Departments of Fisheries, Health and Welfare, and Forestry, and certain Crown corporations and international bodies all exercise a degree of control over water resources in Canada, and so have an interest in related research and development.

69 The serious lack of co-ordination between the many agencies authorized to carry on research in water resources was apparent during the course of the inquiries of the Commission. Some of the inadequacies of water resource research could be overcome by a modernized Water Resources Branch, strengthened by the integration of some water resource groups from other agencies. For example, hydrometeorologists could be seconded from the Department of Transport; all hydrometric work could be done in the Branch, including that now undertaken by the Hydrographic Survey. The industrial water surveys of the Mines Branch could be transferred, as could various agencies concerned with water pollution.

70 The capacity to do high quality research in hydrology and related matters in Canada is limited by the lack of qualified scientists. It is rare for professional personnel in the Water Resources Branch to proceed beyond the Master's degree. There is urgent need to correct this situation.

71 Data-collecting needs to be improved in kind and quality. To make the results available for research and engineering purposes, there is need for improved techniques of data-processing. Present facilities for making data available to the public in the form now required are inadequate.

72 In order to place water resources on a sound basis in Canada, scientific hydrology

must be established in the universities. This is essential in view of the fundamental importance of water—for power, industry, agriculture, fishing, domestic purposes and recreation. Leadership can come only from the federal level. A strong government research and development agency, equipped with modern laboratory facilities is a first requirement.

Conclusions

73 Research relating to water resources now suffers from excessive fragmentation. Although, as was seen, many departments and agencies are vitally concerned with the conservation, development and use of water resources, responsibility for research is to be found in three principal locations: the Department of Mines and Technical Surveys, the Meteorological Branch of the Department of Transport, and the Water Resources Branch of the Department of Northern Affairs and National Resources. Only in the first department is there a general orientation towards scientific research. Closer association of these activities in that Department would therefore be of undoubted benefit. It is noted, however, that the research aspects of the work of the Water Resources and Meteorological Branches cannot be dissociated from their other responsibilities. The broader question of the proper location of these branches is dealt with by your Commissioners in the final report in Volume 5.

DEPARTMENT OF TRANSPORT

Meteorological Branch

74 The Meteorological Branch of the Department of Transport has as its main responsibilities the observation and assembly of weather data, and the forecasting of weather, air and ice conditions in Canada and adjacent oceans. The Branch consists of six divisions: Forecast, Research and Training, Instrument, Basic Weather, Climatology, and Administration. Research and development are

primarily, but not exclusively, the responsibility of the Research and Training Division. This unit also provides in-service training for the large number of new recruits added to the staff in training each year, and this is its most demanding duty. Research is also conducted by the Climatology Division, and the Instrument Division undertakes the design and development of instruments employed in making observations. Some research is performed by individual staff members at forecast offices throughout Canada, with guidance from headquarters. The Branch is attempting to improve its research facilities and to attract specially qualified meteorologists to its research staff.

75 The main areas in which research and development are being carried out at present are listed hereunder:

- At Toronto Head Office:
 - a. Instrument development

Development of instruments and equipment for observing and recording temperature, wind pressure, humidity, ceiling, visibility, et cetera, over land, water and ice, at earth's surface and in the upper air.
 - b. Physical Meteorology

Application of methods of laboratory physics to study of the atmosphere; studies relate to ozone, radiation, air pollution, turbulence, energy budget and cloud physics.
 - c. Dynamic Meteorology

Study of the atmosphere in motion, including general circulation and the theoretical basis of numerical weather prediction.
 - d. Synoptic Meteorology

Study of the structure and state of the atmosphere and its changes with time for purposes of weather prediction—fronts, jet streaming, aircraft hazards—using the results of dynamic meteorology research and empirical techniques.

e. Climatology

Application of meteorological parameters to the Canadian economy, including micrometeorology, hydrometeorology, Arctic climatology, and research related to agriculture, forestry, construction and hydrology.

- At Central Air Office, Dorval Airport:

Central Weather Analysis and prognosis
Research designed to develop and evaluate techniques for forecasting weather over the whole of Canada from one location, includes use of numerical prediction methods.
- At forecast offices throughout Canada:
 - a. Local forecast studies, mainly statistical, covering fog formation, ceilings, temperature, pressure, cloud formation, et cetera.
 - b. Operational research in fields such as dynamic meteorology (jet streams and other upper atmosphere phenomena).

76 Growing demands for collaboration in agricultural research, hydrology, and ice observation and forecasting, are putting added strain on the research resources of the Branch, which have been inadequate for many years. The Branch has an insufficient number of able scientists to carry on all the necessary activities simultaneously. Operations have the first call on personnel, funds and facilities. There is also a problem in recruiting the right type of meteorologist. Outstanding research results can hardly be expected from meteorologists after they have been engaged for years on routine observing and forecasting on a shift basis. Yet the research positions are naturally attractive to such men, and seniority carries weight when appointments are made. There is at present no direct entry to research appointments for qualified scientists without routine meteorological operating experience, and scientists, interested mainly in research, are rarely attracted to ordinary meteorological vacancies.

77 Canada has pioneered in the design and development of instruments for making meteorological observations under severe climatic conditions and in remote locations. Some of these instruments, conforming to the essential high standards, are manufactured in the Branch's workshops from commercially made parts. Patents or other types of protection have rarely been secured.

78 The time would seem opportune to establish a modern centre for research and development in this increasingly important field. Better physical facilities are required, and also some reorganization of the staff with a strengthening of its scientific content. There is a well-established system of seconding Branch meteorologists, including those engaged in research, to other departments, and this has been more than justified. The scientific results achieved by the present small

group of secondments is most encouraging; the time is approaching when this programme will need to be greatly extended.

79 The Canadian Meteorological Service, the third largest in the world, is a comparatively autonomous subdivision of a Department whose functions are predominantly operational and regulatory. From a research standpoint, this location is far from ideal. The small group of research scientists in the Branch are out of tune with typical departmental activities and administrative personnel. However, as was noted in connection with the work of the Branch relating to water resources, its scientific research activities cannot be dissociated from its other overshadowing responsibilities, and the general question of the proper location of the Branch must be left for consideration in your Commissioners' final report on organization.

3

DEFENCE RESEARCH AND DEVELOPMENT

1 Military scientific research in Canada has evolved in three stages. Up to World War II, military science was the sole responsibility of the Armed Services, and the amount of defence research and engineering carried out was almost negligible. A modest research programme was in hand at the National Research Council laboratories during the period 1936-39, which laid the foundations for the large-scale wartime defence scientific effort. During World War II the responsibility for defence research and development continued in the hands of the National Research Council. Since the formation of the Defence Research Board in 1947, defence research has been almost exclusively the responsibility of that body.

2 In addition to the research and development activities carried on by Defence Research Board establishments, development work is also undertaken independently by the Armed Services, and by Canadian Arsenals Limited, a Crown corporation established in 1945. The Department of Defence Production was given some responsibility in 1959 for stimulating defence development projects in the Canadian manufacturing in-

dustries. In theory, the Services specialize in development and the Defence Research Board in research, but in practice the line between the two is difficult to draw.

DEFENCE RESEARCH BOARD

Organization

3 The Chiefs of Staff Committee is responsible for advising the Minister of National Defence on defence policy, and this responsibility must include defence research and development policy. However, an essentially non-scientific body, such as the Chiefs of Staff Committee, cannot in fact be responsible for detailed defence science policies, and this was foreseen when the Defence Research Board was created. It was for this reason that the Board was given the responsibility for advising the Minister on defence research and development policy.

4 The Board comprises, in addition to the Chairman and Vice-Chairman, the Chiefs of Staff of the three Armed Services, the President of the National Research Council, the Deputy Minister of National Defence and,

at present, seven members appointed from the universities, two members appointed from industry, the Chief Scientist of the Defence Research Board and the Deputy Minister of Defence Production. The Board meets three times a year. It does not act as an advisory body on defence research policy, although the *National Defence Act* prescribes this as its main function. However, the Board does perform three important functions:

- It provides for joint consultations on defence scientific affairs between the Defence Research Board, the Armed Services, the universities and industry.
- Through its selection committee, it is responsible for professional appointments and promotions, and ensures that adequate standards are maintained.
- Through its standing committee on extramural research, it has established twenty-seven advisory committees and panels with membership drawn from government scientific agencies, the universities and industry. These bodies are responsible for screening all applications from the universities for Defence Research Board grants-in-aid of research, and several of the panels act in an advisory capacity in specialized fields of defence science.

5 The Chairman of the Defence Research Board also acts as its general manager. When additional responsibilities devolve upon the Board, there will be a need for some re-organization, and particularly for strengthening the executive functions. The Chairman of the Board should be responsible for advising the Minister on defence research and development policy, and for all the existing functions of the Defence Research Board (including international aspects of Canadian defence science and engineering) except the direct management of the actual research establishments. A senior administrator of the National Defence Laboratories should be appointed, who would be a member of the

Board and have responsibility for managing the laboratories and associated headquarters directorates.

6 The organization chart (Chart 3) shows the Chief of Establishments as the executive officer responsible for the operation of the experimental establishments. In practice, there appears to be some overlap in the responsibilities of the Chief Scientist, the Chief of Personnel, the Chief of Establishments, and the Comptroller. There is clearly some difficulty in the interpretation of the terms of reference of these senior executives. The same problem arises in the definition of the respective roles of, and relationships between, the headquarters scientific directorates and the experimental establishments.

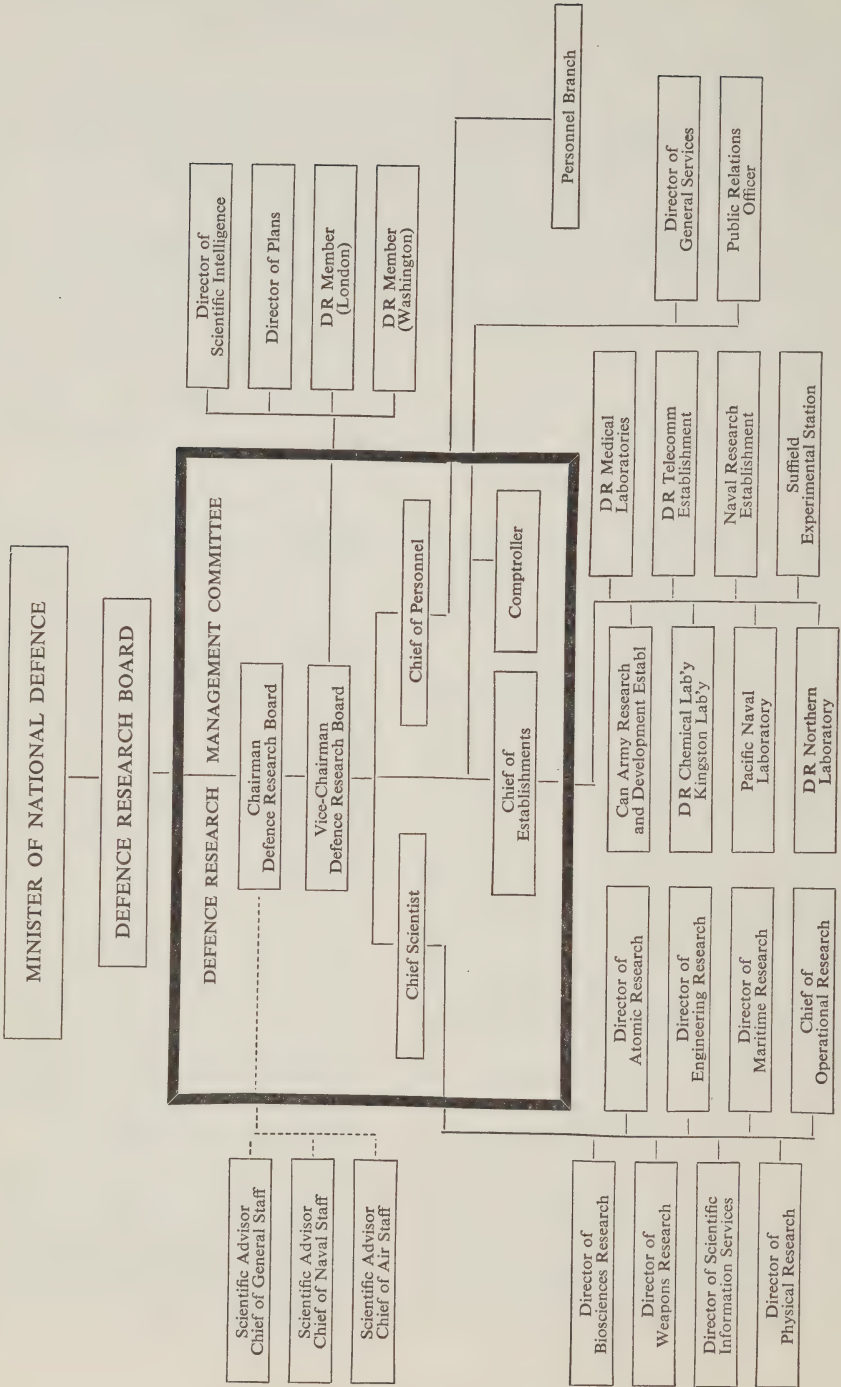
7 An operational research group, consisting for the most part of Defence Research Board personnel, is integrated into each of the Armed Services. In addition, the RCAF has established, under a senior Defence Research Board Scientist, a defence systems evaluation group. Apart from several small sections attached to operational units of the Services, these groups are based at National Defence Headquarters. Each group is carrying out effective analytical work. This aspect of the activities of the Defence Research Board has been highly praised by the Armed Services.

Research and Development Programmes

8 The magnitude and scope of defence research and development programmes and their security classification preclude a detailed description in this report of even the major projects. Comment is limited to certain aspects of the programmes.

9 The research programmes of the Defence Research Board Establishments appear to be balanced adequately between basic and applied research. There is particular emphasis on the latter, even at the expense of develop-

Chart 3 — ORGANIZATION OF DEFENCE RESEARCH BOARD — SEPTEMBER 1961



ment work, because defence science is, almost by definition, applied research.

10 The research programme at the Canadian Armament Research and Development Establishment (CARDE), the largest Defence Research Board establishment, is particularly well-balanced, with the major effort in applied research. Some aspects of the research programme have attracted international interest. For example, CARDE hypersonic range facilities for the study of ballistic missile re-entry phenomena are among the most advanced of any in the NATO countries, and a considerable part of this programme is being financed by the United States Army Rocket and Guided Missile Agency.

11 An important aspect of CARDE is the close collaboration between the establishment and the Canadian Army. The future evolution of Canadian defence programmes may perhaps be patterned on the CARDE model, which has proved that joint development programmes can be effectively co-ordinated and executed. The research programmes at the Pacific Naval Laboratory and the Naval Research Establishment are to a large extent complementary, and it is suggested that the possibility of developing a co-ordinated programme, involving both establishments, should be studied. Canada has already made notable contributions to research in anti-submarine warfare, especially in connection with the development of Variable Depth Sonar; a well integrated naval research programme, with emphasis on no more than two or three major projects, should help to increase the country's contribution in this field.

12 Similarly, portions of the programmes at the Defence Research Chemical Laboratories and at the Suffield Experimental Station are complementary, especially in the fields of chemical and biological warfare. Since this area of research is closely co-ordinated with

programmes in the United Kingdom and the United States, it may not lend itself to closer co-ordination with other programmes in defence research. At present, however, there are thirty-five projects in hand at the two establishments, and the selection of one or two major areas for study by comparatively large teams would appear to be a logical move.

13 Two sections of the Radio and Electrical Engineering Division of the National Research Council, Defence Sections I and II, are still concerned with defence research and development in radar and electronics. During the past twenty years these sections have made notable contributions to radar and electronics research. Nevertheless the continuance of this work within the National Research Council is anomalous, and it is suggested that consideration be given to the eventual transfer of the two defence sections to the Defence Research Telecommunications Establishment within the Defence Research Board.

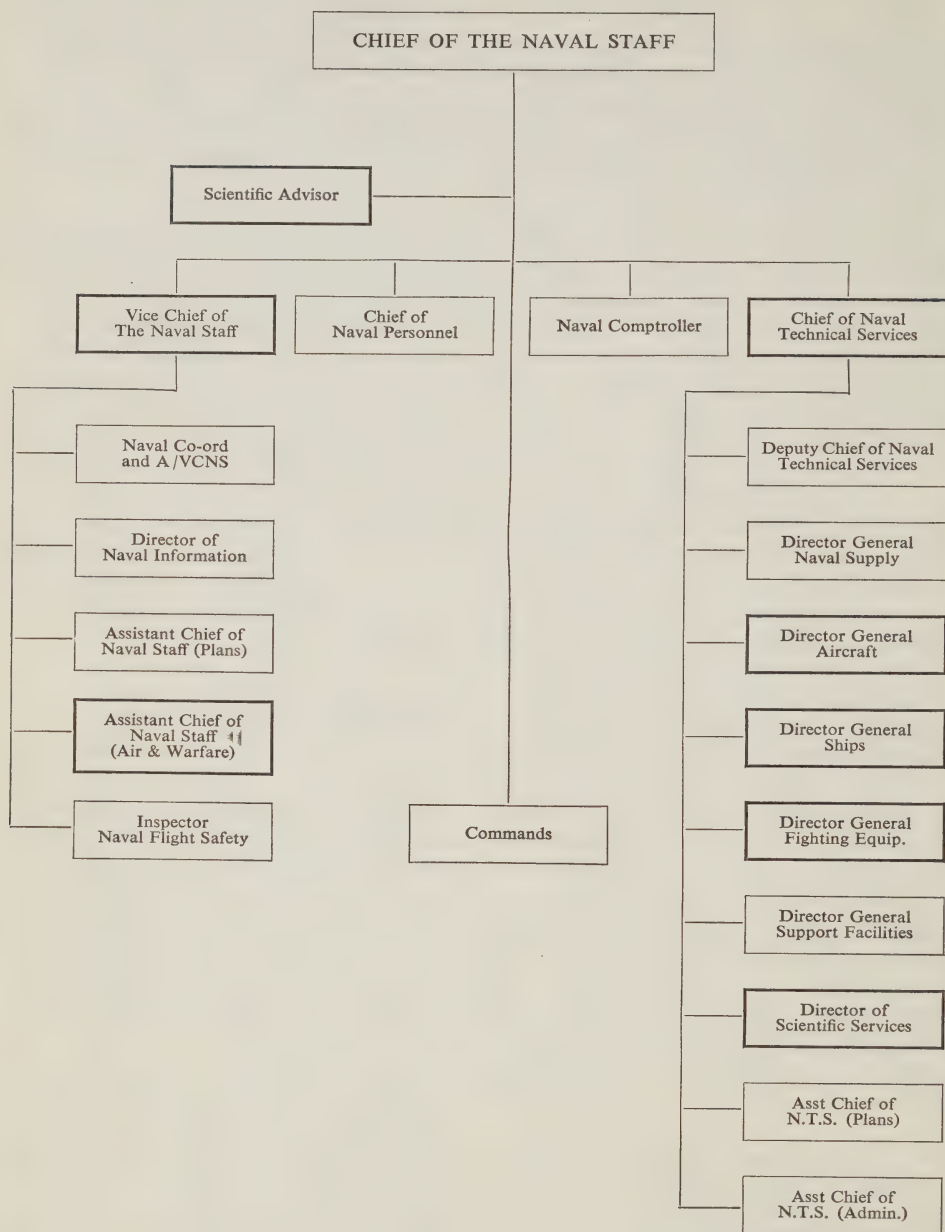
ARMED SERVICES DEVELOPMENT DIRECTORATES

Organization

14 The directorates principally involved in development work in the Armed Services are shown in the simplified organization charts 4, 5 and 6. While there is some attempt in the Army organization to co-ordinate development work within a single body (the Army Equipment Engineering Establishment), no like attempt appears to have been made by the Navy or Air Force.

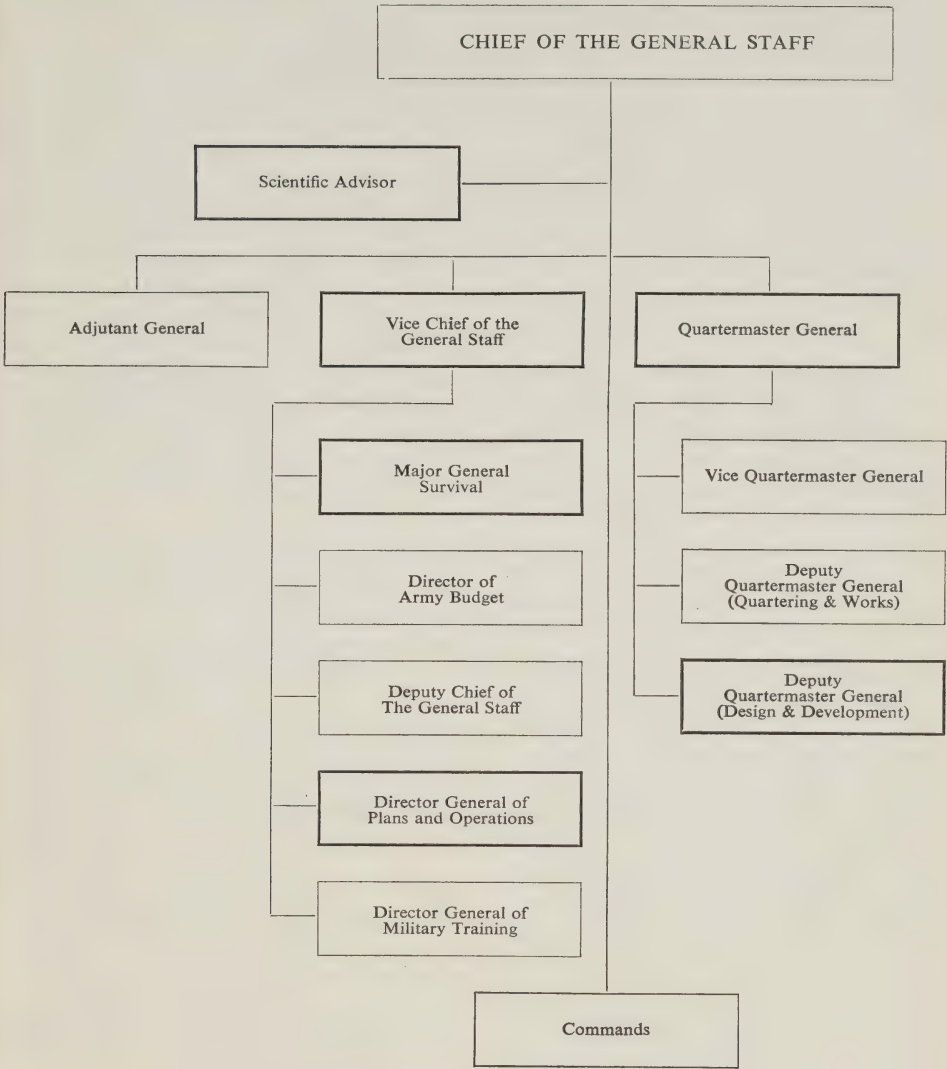
15 The Royal Canadian Navy development programmes, both 'in-house' and extra-mural, come under the Chief of Naval Technical Services. The Director of Scientific Services is also the Director of Maritime Research, Defence Research Board; on the one hand, he monitors the naval development programmes for the RCN and, on the

Chart 4—RESEARCH ORGANIZATION IN THE ROYAL CANADIAN NAVY



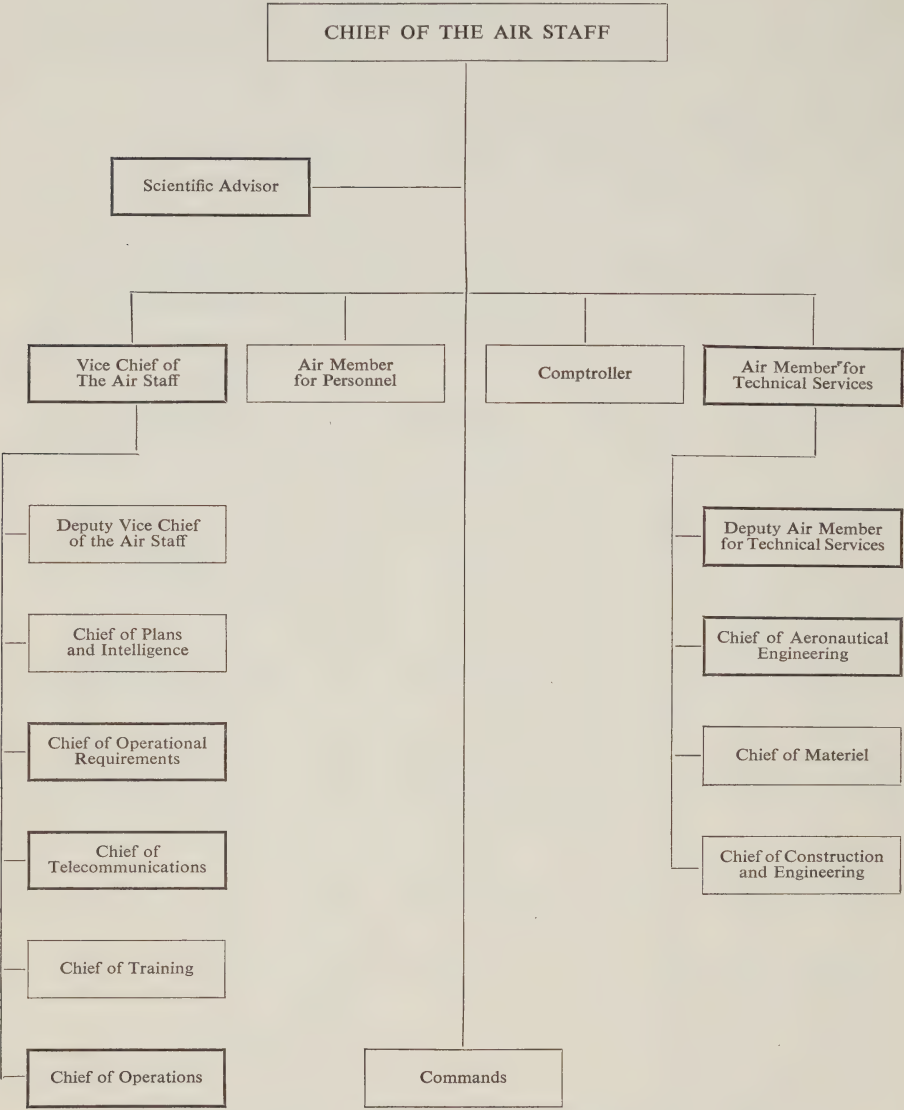
Heavy lines indicate RCN Branches and Directorates concerned with Research and Development Programmes.

Chart 5—RESEARCH ORGANIZATION IN THE CANADIAN ARMY



Heavy lines indicate Army Branches concerned with Research and Development Programmes.

Chart 6—RESEARCH ORGANIZATION OF THE ROYAL CANADIAN AIR FORCE



Heavy lines indicate R C A F Branches concerned with Research and Development Programmes

other, he advises on the technical aspects of programmes as a member of the staff of Defence Research Board.

16 The development programmes of the Army are the responsibility of the Deputy Quartermaster General (Equipment Engineering), who controls the two branches concerned with development—the Army Equipment Engineering Establishment and the Directorate of Equipment Engineering. The Army development programmes are planned and co-ordinated by the Army Research and Development Committee, whose chairman is the Deputy Chief of the General Staff. Examples of extreme fragmentation are the Directorate of Equipment Engineering comprising twenty-five sections, and the Army Equipment Engineering Establishment with forty-eight sections.

17 The RCAF development programmes have always been the largest in the Armed Services. The lack of co-ordination in the development branches and sections may be illustrated by the following examples:

- The Director of Systems Evaluation is responsible to the Chief of Operational Requirements, while the closely associated Operational Research Directorate is responsible to the Chief of Operations.
- The Director of Air Defence Systems Integration is responsible to the Deputy Air Member for Technical Services, while the Director of Radar and Data Processing is responsible to the Vice-Chief of the Air Staff through the Chief of Telecommunications.
- All RCAF development proposals pass through the office of the Assistant for Aeronautical Engineering Management, but this office constitutes a financial control, and has no responsibility, or indeed capability, for co-ordinating the development programmes.

Development Programmes

18 In spite of several important development programmes conducted jointly by the Armed Services and the Defence Research Board, approximately fifty per cent of the total national defence research and development expenditures is for projects that are not the direct responsibility of the Defence Research Board.

19 Several examples of undue overlapping and even duplication of development programmes have been noted. Three cases are outlined below:

- Electronic counter-measure programmes are being undertaken by various agencies and, although co-ordinated by a committee, the actual development work is being carried out in three independent laboratories—the National Research Council defence sections, the Instrument and Electronic Division of Canadian Arsenals Limited, and the Defence Research Telecommunications Establishment.
- The RCAF Directorate of Airborne Telecommunications is concerned with the development of some aspects of moored sonar buoy submarine detection and location systems, and with the magnetic detection of submarines (in conjunction with the National Aeronautical Establishment); associated programmes are in hand at the Defence Research Telecommunications Establishment, the Naval Research Establishment and the Pacific Naval Laboratory.
- There is little collaboration between Defence Research Board experts in digital data processing systems and the RCAF and RCN directorates concerned with such complex systems as the SAGE and corresponding systems for naval applications.

CANADIAN ARSENALS LIMITED

20 Canadian Arsenals Limited was formed as a Crown corporation in September, 1945.

Although its major function is the production of military stores and equipment to the order of the Department of Defence Production, the corporation has two other significant functions:

- The development of new military equipment for the Services.
- The development and planning of new manufacturing processes.

21 At present, except in one special electronic counter-measure programme, there is no mechanism for co-ordinating the corporation's work in defence development with that of other agencies, and the President and Board of Canadian Arsenals Limited are responsible to the Minister of Defence Production.

22 The Canadian Arsenals development programme is dependent, almost exclusively, on programmes initiated by the Armed Services and the Defence Research Board. During 1960-61 the combined development expenditures in the corporation's arsenals and the gun ammunition, small arms, filling, and explosives divisions amounted to only \$76,000. Unless adequate funds are provided to support these vital development groups, they will rapidly become hopelessly out-of-date.

23 During the past decade, the Instruments and Electronics Division has been responsible for the major portion of the Canadian Arsenals development programme. It is a first-class group and has made important contributions to developments in radar, electronic countermeasures and air navigation systems. In spite of this impressive record, it remains difficult to state a case for the continuance of the Instruments and Electronics Division within the framework of a Crown corporation. The group is isolated and has no knowledge of future programmes, so that long-term planning is impossible. Two possibilities for the re-location of this work merit

consideration. The development sections of the Instruments and Electronics Division might be incorporated with the Defence Research Telecommunications Establishment. The Canadian electronics and applied electronics industry has made great strides in research and development during the past decade, and it appears to your Commissioners that the existing electronics development programme of Canadian Arsenals Limited should be contracted out to private industry.

DEPARTMENT OF DEFENCE PRODUCTION

24 Since 1958, the Department of Defence Production has had responsibility for the conduct of the Canadian-United States defence production-sharing programme, initiated in that year. This responsibility in turn gave rise to the associated development-sharing programmes within Canadian industry. More recently, in January, 1961, the Department of Defence Production submitted a case for long-range industrial applied research planning for production-sharing. A committee of representatives of interested government departments was set up to review and to recommend the support of suitable development projects, and to monitor the financing and control of such programmes.

CONCLUSIONS

25 The ramifications of the foregoing survey amply reflect the complex state of defence research and development in Canada and should make one thing clear: the marked lack of co-ordination that exists both within and between the principal defence research and development agencies.

26 As has been stated, the principal intended function of the Defence Research Board was to co-ordinate defence research policy. That it has not exercised this function has been less damaging to Canada's defence contribution than the fact that it has not been responsible, either statutorily or in practice,

for the co-ordination of the development function. To a certain extent, basic and applied research require autonomy and a freedom for the individual scientist to go his own way. But if development policy is equally unco-ordinated, serious damage may result to the effectiveness of Canada's defence system.

27 In principle, the Department of National Defence Development Committee, under the chairmanship of the Chairman, Defence Research Board, is responsible for the co-ordination of the Armed Services development programmes which are covered by development votes. These votes apply mainly to Armed Services development contracts with industry, totalling some \$12 million a year, as distinct from development programmes carried on by the Services within their own establishments. The Committee meets only once each year and deals almost exclusively with the extra-mural development budget proposals.

28 But although the Board approves the development contract demands of the Armed Services, it has no responsibility for the subsequent conduct of the work. It is also apparent that the Defence Research Board has not the manpower to devote adequate time to investigating the potential value of all development proposals. This is due mainly to the complex procedures involved in the processing of industrial development contracts. The average time taken by the Board to process Army contract demands is about three weeks, which must be regarded as insufficient for thorough investigations. However, for the majority of the Armed Services 'in-house' development programmes, there is in fact no scrutiny at all by the Defence Research Board of the scientific and technological merit of the projects. It would thus appear that the monitoring of the Armed Services development programmes by top-class defence scientists and engineers is limited. There is evidence of too hasty initiation

of industrial development projects, giving rise to excessive numbers of amendments to development contracts and additional time-consuming processing procedures.

29 Two points remain to be made concerning defence science personnel. First, the defence scientist occupies a special position because his work is frequently subject to security regulations, which inevitably involve some restriction on the publication of his results. Accordingly, for the average defence scientist, career prospects in other scientific occupations, including for example university teaching and research, may be prejudiced. There is therefore some justification for giving the defence scientists special dispensations in the form of fringe benefits, such as attendance at summer schools, special travel grants, a liberal attitude towards those invited to give lecture courses at the universities, and permission to attend special graduate courses during hours of duty. There may otherwise be a tendency in the future for inbred characteristics to develop in the Defence Research Board.

30 Second, the Armed Services are encountering increasing difficulties in recruiting qualified scientific personnel. At present the career prospects of the majority of technical staff-officers, within the framework of the Armed Services, are not encouraging and are less attractive than those of the non-specialist. The Service environment is not conducive to excellence in high-level defence science and engineering; and the tour of duty requirement, which frequently means that an officer may spend only three or four years in an appointment before being posted to an entirely different field, is a further bar to the recruitment of the scientist or engineer. The basic character of the existing problems suggests that a special study dealing with the future role and career prospects of military technical staff would be fully justified.

31 The importance of the Defence Re-

search Board as the top-level defence research and development policy advisory body has been discussed in Part 1 of this report. From the standpoint of the conduct of defence research and development programmes, a strong central policy advisory body will become increasingly important in the future.

32 The large number of research and development groups and the correspondingly large number of projects in hand testify to the fragmentation in defence research and development programmes, reinforcing the view that the selection of projects, especially the Armed Services' development projects, is

not well co-ordinated. The formation of strong groups to undertake projects of major importance, the elimination of other projects, and the statement of well-defined aims are all important requirements.

33 Because of increasing expenditure in defence development, the time is now ripe for the Defence Research Board to study the long-term aims and objects of Canadian defence research and development programmes, with a view to forming a long-term defence science policy and thereby minimizing the possibility of serious discontinuities.

4

THE NATIONAL RESEARCH COUNCIL

1 In Part 1 of this report your Commissioners discussed the constitution and role of the National Research Council and its relation to the government and to scientific research in general. In the following survey, consideration is given simply to the Council's internal research activities.

2 The organization of the National Research Council is shown in Chart 7. It consists of eleven scientific and engineering divisions, two of which are regional laboratories. The numbers of staff at January 1st, 1960, are given in brackets.

3 The divisions are each headed by a director who reports to the President. Each division includes a number of sections headed by senior scientists usually classified as Principal Research Officers.

RESEARCH PROGRAMMES

4 The work in the National Research Council laboratories is not assigned on a project basis. The emphasis is put rather on fields of research. The divisional sections each operate more or less independently in a

particular scientific field. The following are brief descriptions of the scientific work of the divisions.

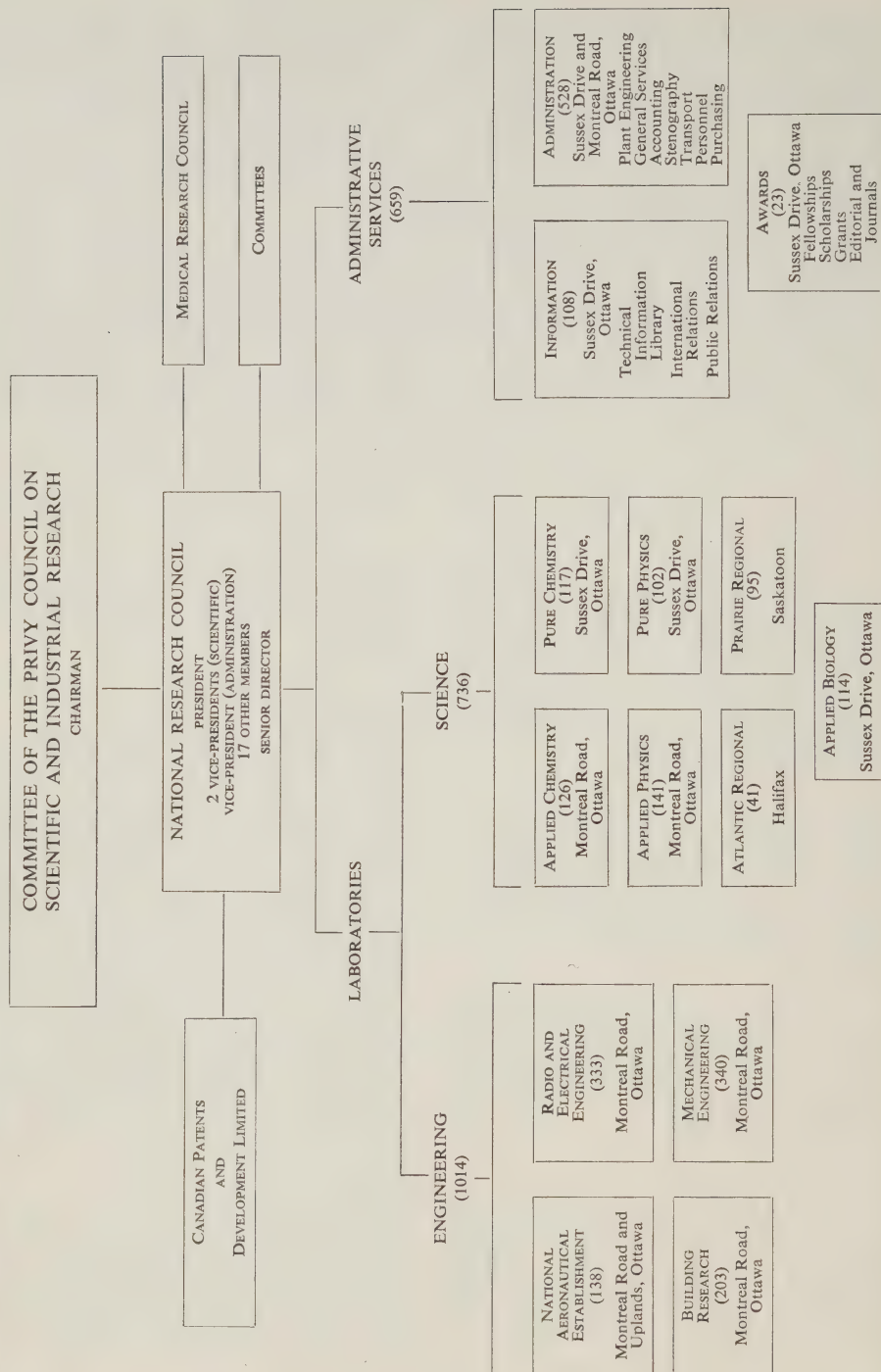
Building Research

5 The main function of the Division of Building Research is to provide a research service to the construction industry of Canada. It assists Central Mortgage and Housing Corporation on special technical housing research and provides the secretariat and necessary technical assistance to the Associate Committee on the National Building Code. The research programme of the Division includes work on all main building materials except wood, mechanical services for buildings, foundations and soil mechanics, all aspects of house design and construction, fire research and a variety of other services.

Mechanical Engineering

6 This Division works mainly in mechanics, hydrodynamics and thermodynamics. The mechanics activities include mathematical analysis and computation, instruments and

Chart 7—ORGANIZATION OF THE NATIONAL RESEARCH COUNCIL



servo-mechanisms, and research on mechanical devices such as gears. The hydrodynamics research and development work is divided into hydraulics work pertaining to harbours and rivers and hydrodynamic aspects of naval architecture. The thermodynamics laboratories deal with further aspects of fluid mechanics and especially with the problems of reciprocating engines and turbines, with the characteristics of fuels and lubricants, and with the special cold weather and icing problems important in Canada.

National Aeronautical Establishment

7 The research programme of the National Aeronautical Establishment, which is concerned with problems of aerodynamics, aircraft structures and materials, and flight mechanics, is described in some detail in chapter 5.

Radio and Electrical Engineering

8 Roughly half of this Division's work consists of defence projects involving the development, production, and evaluation of new equipment. The rest of the research programme involves fundamental problems in electronics, electrical engineering, and radio science, as well as applied research in such fields as the application of electronics to navigational aids, instruments for inclusion in satellites, medical electronics, and long distance power transmission, with special emphasis on applications of interest to Canadian industry.

Applied Chemistry

9 The Division seeks to provide information needed in the development of Canada's natural resources and chemical industries. Much of the work concerns petroleum and corrosion chemistry.

Pure Chemistry

10 The Division is concerned with fundamental investigations in physical and organic chemistry. There are thirteen sections, twelve

of which study long-term problems; the thirteenth prepares substances needed by the others. The work in organic chemistry includes investigation of the structure of alkaloids, studies of the infra-red spectra of steroids, the synthesis of porphyrins and of compounds labelled with isotopes. Other sections deal with chemical kinetics and photochemistry, the study of the ionization potentials of free radicals by mass spectrometry, Raman and infra-red vibrational spectroscopy, and the application of high resolution proton magnetic resonance techniques to the study of hydrogen bonding and other molecular interactions. Still others study aspects of surface chemistry such as the thermal properties of simple solids and imperfections in the bulk and the surface of alkali halide crystals, and the thermodynamics and stress-strain relationships associated with the absorption of fluids by active carbons.

Applied Biology

11 This Division's programme covers practical problems related to the national economy, and fundamental investigations in plant and animal physiology, microbiology, biochemistry and biophysics. Problems of preparing, preserving, and storing goods constitute a large part of the work. The Division is investigating the physiological and biochemical changes in mammals, birds and man in adapting to cold. Other fundamental work includes the structure and function of plant cells, the chemistry of proteins and lipoproteins, the composition and structure of carbohydrates and fats, and the metabolism of non-pathogenic micro-organisms that are important in the food and fermentation industries.

Atlantic Regional Laboratory

12 Practical and fundamental investigations related to the resources and industries of the Atlantic provinces are carried out. They include more efficient methods for dry-

ing plant materials, the problem of slime in the "white water" of Canadian pulp mills, basic chemistry in the fabrication of steel, and the processing of industrially important seaweeds.

Prairie Regional Laboratory

13 The Laboratory studies chemical, biological and engineering processes for turning agricultural crops into industrial raw materials or commercial products. For some time the Laboratory has studied major plant constituents such as carbohydrates, protein, starch, lignin and fibres. Attention is now being given to the minor components—such as phenols, flavonoids and terpenes, which are known to have fungicidal and germicidal properties—both individually and as they affect the processing and behaviour of the major constituents. The development of oil seed crops as alternatives to cereal crops constitutes an important part of the laboratory's work.

Applied Physics

14 The work is divided between research projects of potential practical value and development of the fundamental standards on which measurements generally are based. All the fundamental physical standards for Canada are housed and serviced in this Division, which now holds primary standards equal to any in the world in the fields of mass, length, time, electricity, temperature, light, and ionizing radiations. Industrial problems receive much attention, particularly calibration work and industrial noise abatement. Work is done in such fields as aerial mapping, rocket propellants and diagnostic radiography. The possible use of plasma motors to propel rockets in outer space is being investigated. The radiations group has made a study of the gonadal dose received by adults in diagnostic radiography, and has entered the field of radiochemistry to be able to measure radio-isotopes more effectively.

Pure Physics

15 The work is on long-range fundamental problems that do not have immediate application but advance knowledge generally and provide the basis for further progress in the applied fields. The Division's work includes fundamental studies on cosmic ray measurements using rockets flown to high altitudes; the electrical, thermal and mechanical properties of metals and semi-conductors; the spectra of atoms and simple molecules with a view to determining their structure; theoretical problems in atomic, molecular and nuclear physics; molecular and crystal structure; and identification problems for government laboratories.

The Laboratories

16 The National Research Council Laboratories represent the largest single research complex in Canada. Their activities, as already described, include pure and applied research in physics, chemistry, biology, and civil, mechanical, electrical and aeronautical engineering. Inevitably the programmes and organization are as much a result of past events and personalities as they are a matter of policy. The laboratories are recognized both nationally and internationally as doing research of the highest calibre. They have grown very rapidly during the past few years, from essentially a single establishment to a group of large research divisions, each with increasing independence.

17 Pure research is conducted by the National Research Council in two different environments. In the Pure Physics and Pure Chemistry Divisions it is conducted in relative isolation from the other activities of the Council, except as part of the scientific community as a whole. In the applied research and engineering divisions some pure research is also conducted alongside applied research, development, engineering and other activities. The conduct of pure research is the key to the attraction of top-quality creative

scientists, in which the National Research Council has been singularly successful. However, it has long been recognized that even pure research benefits from the feedback of problems from related applications, and that the best balance between pure research conducted in isolation and that conducted in proximity to applied research is a matter for continual review.

18 The physics, chemistry and biology divisions conduct pure and applied research of a kind and quality traditionally associated with the universities. They have an excellent record of scientific publication, which is actively encouraged, and have attracted and developed a number of outstanding scientists.

DIRECTION OF RESEARCH PERSONNEL

19 There is a deliberate policy of restraint from the direction of research, arising from an obvious and understandable fear of inhibiting the freedom of the creative scientists. The policy regarding the direction of research is summarized in the following paragraph extracted from a submission by the National Research Council to the Commission:

Each Research Director is responsible for the scientific programme of his Division. He has the authority and responsibility to initiate work in a new field and to terminate work in another field. The Director in turn generally delegates full authority and responsibility to his Section Heads who are responsible for a special field within the spectrum of the Division's interests. As far as the basic research programmes are concerned it is the job of the Director to protect the scientists from outside direction rather than telling them what to do. The control by the Director, the President, and the Review Committee of the Council is largely indirect by way of encouragement, of criticism, etc.

20 The retention of this freedom is the most important single factor in the operation of research laboratories. The National Research Council has created an environment for research in its own laboratories which

is unrivalled in academic freedom even by Canadian universities, where considerable emphasis is placed on teaching commitments. Indeed, the very success of the National Research Council in this regard may lead to the criticism that it has attracted to itself men who should be building up schools of scientific research in Canadian universities.

21 Restraint from direction has had further effects than those intended. The policy assumes that the majority of scientific staff have convictions about what they wish to do; that they are able to exercise critical judgment on their own work; and that they can maintain the sense of urgency necessary to a research environment. These assumptions may not be universally valid. The problem is to maintain an environment suitable for highly creative work and at the same time provide guidance and direction when needed.

22 Some quite senior personnel desire direction and guidance in the selection of their research, as distinct from its conduct, particularly in the form of clear statements of the policies, aims and objectives of their particular group. There is an evident reluctance in some places to seek such guidance in the face of the over-all policy quoted.

23 The policy neither to limit the scope of research nor, in some instances, to direct it, has resulted in a programme which is, in places, diverse and thinly spread. Sufficient attention has not yet been paid in every case to the selection of programmes that are either of fundamental scientific importance, of current scientific interest or, in applied research, of ultimate practical and economic significance. At the same time, insufficient stimulus appears to be given to a scientist to terminate a scientifically unproductive programme.

24 The age distribution of National Research Council scientists has become a matter for concern. The high influx of staff

in the late 1940's now reflects a peak in the age distribution at about thirty-eight. There is no obvious outlet for the forty-year-old whose creativity is generally regarded as passing its peak in this decade of life. In a university he would turn more and more to teaching and away from research. There are signs that some of the fragmentation of divisions is due to a desire to create senior positions for these men. Initial appointments by the National Research Council are for limited terms, succeeded by terms of increasing length before the appointment becomes discretionary. Advantage has not been taken of the existing regulations governing temporary appointments to enforce a healthy degree of turnover in the research staff. By far the greatest turnover is now among Post-Doctorate Fellows.

25 The Post-Doctorate Fellowship Scheme of the National Research Council is one of the most highly regarded fellowship schemes in the world. It provides a flow of high-calibre scientists and engineers who bring the benefit of training received in many parts of the world. They not only perform much useful work, but serve as a stimulus to the permanent staff. Since the scheme was started in 1950, over one thousand Fellows have passed through the National Research Council laboratories. It has also been extended to include appointments to Canadian universities and other government departments, although the numbers allocated to the latter do not yet approach those in the National Research Council. It has not yet been extended to industrial research laboratories.

26 Most Post-Doctorate Fellows come from outside Canada, and many return to their

own countries after completing their Fellowships. The Post-Doctorate Fellowship scheme is *not* successful in attracting Canadians, who have so far represented only eight per cent of the Fellows. This is almost certainly due to the fact that the stipend offered is far more attractive to a scientist overseas than to a Canadian who has job offers at Canadian salary levels. As mentioned above, the greater part of the turnover of scientific staff is among the Post-Doctorate Fellows, and the age-distribution of the permanent staff is thereby unbalanced—the one possible disadvantage of an otherwise admirable scheme. One or two Divisions have a high proportion of Fellows; in one, the ratio of thirty-eight Post-Doctorate Fellows to twenty-two research staff implies a turnover of about one-third to one-half the research scientists every year. The Council might profitably re-examine the proportion of Post-Doctorate Fellows to permanent staff in each Division, from the point of view of its effect on the continuity of research.

27 The engineering divisions, which spend the greater part of the laboratory research budget, are undoubtedly a problem to an administration which has concentrated its effort so successfully on the support and encouragement of fundamental research. While the *ad hoc* selection of research programmes may be admirable if the sole responsibility of the division is to do pure research, it sometimes leads, even then, to excessive diversity. In an engineering division the results may be still more serious. The requirement for a large number of engineering staff, who have no counterpart in the science divisions, further accentuates the difference between the science and engineering divisions.

5

CO-ORDINATION OF NON-DEPARTMENTAL RESEARCH

1 Most research not related to departmental or agency operations is now undertaken by the National Research Council, the Defence Research Board and Atomic Energy of Canada Limited. However, some research in this category remains the responsibility of one or more departments and agencies. Four such areas of research are examined in this section, and certain principles for the organization of all non-departmental, civil scientific research will be enunciated.

2 The National Research Council has, as noted earlier, established an international reputation for general excellence. In the civil sector it now has responsibility for the lion's share of non-departmental research, if Atomic Energy be excluded. It might well take over all such research, thereby reducing the present fragmented nature of government research and placing non-departmental research activities in a sympathetic and expert environment. The effect of this and earlier recommendations would be to reduce to manageable proportions the number of agencies with research interests, and to provide the benefits which can best be derived

from strong central supporting services and expert direction in a scientific environment.

3 Within the National Research Council, the engineering divisions tend to be self-sufficient, each including work that runs the gamut of activities from research to engineering. It appears certain that if the aims of these divisions were more clearly defined, their programmes would be more coherent and effective and their co-ordination with industry better developed. This is borne out by the experience of the Building Research Division.

4 At present, however, there is a widespread feeling that fundamental research is the only activity adequately recognized within the National Research Council. The recruiting and selection boards operate to some extent on this assumption. Much emphasis is placed on academic records and quantity of publications, both for recruiting and promotion. The engineering divisions engage in a great deal of pure and applied research, development, and engineering activities for which a wide variety of capabilities is needed.

But there is no corresponding variety of grades or of criteria for the selection of their professional staff. The various factors to be weighed when hiring a professional engineer may be quite different from those considered when appointing a research scientist. The problems of selecting and directing research programmes and those of personnel administration would be eased by having the engineering divisions report to the President through a separate channel from the science divisions, and by giving each unit a more independent status.

5 This would involve some changes in the organization of the National Research Council, which would not be dramatic. The Division of Building Research has already achieved a degree of independence unmatched by other units. The other divisions should be allowed the same autonomous status. In addition, some of the research units now placed in the departments should be brought within the National Research Council framework. These "satellites" would report to the Council through a new Vice-President, whose responsibility for their administration would be limited to the broadest aspects of financial and programme control.

6 The National Research Council's main operational responsibilities would be the management of its own pure and applied science laboratories, the scholarships and grants-in-aid programmes through which it has been largely responsible for the growth of research in the sciences and engineering at Canadian universities, and the provision of common administrative services.

7 No detailed plan of operation of the satellite system is outlined here, nor is any all-inclusive list proposed for the research areas that might be included. Four of these are discussed in some detail immediately hereunder: Oceanography, Astronomy, Aeronautics, and Space. Responsibility in these fields is now divided. Each is essentially

non-departmental in character and would be well situated within the National Research Council as a semi-autonomous body.

ASTRONOMY

8 Several departments and agencies of the Canadian government are active in astronomy.

9 The Dominion Observatories Branch of the Department of Mines and Technical Surveys is a complex of astronomical and geophysical establishments. It is a true research organization with few other responsibilities.

10 There are seven divisions of the Branch, four concerned with astronomy and three with geophysical phenomena. These are: Positional Astronomy, Stellar Physics, Dominion Astrophysical Observatory (Victoria) and Dominion Radio Astrophysical Laboratory (Penticton) in the first group; and Gravity, Geomagnetism and Seismology in the second. Each division is administered scientifically as a separate laboratory and there is little or no interchange of personnel, although at small and remote sites some co-operative observation occurs.

11 The trebling of the cost of operations of the Dominion Observatories Branch in the past few years is attributable in part to extension of its work to distant places, particularly in the far north where costs are high. There have also been large expenditures on new equipment.

12 Research in radio-astronomy has also been carried out recently in the National Research Council (Radio and Electrical Engineering Division) and in the Defence Research Board (Defence Research Telecommunications Establishment). It has arisen out of interest in the electronic techniques rather than from a fundamental interest in astronomy. Research in radio-

astronomy requires expensive apparatus; the facilities of the Radio Astrophysical Laboratory in Penticton cost approximately \$1 million. The National Research Council already has extensive facilities on a less favorable site in Algonquin Park and proposes to install there a larger telescope than that at Penticton. The Algonquin Park facilities also serve the University of Toronto, but it is doubtful whether their separation from the main body of astronomy in Canada can be justified on these grounds alone.

13 There is little to recommend the present administrative association of astronomy with geophysical activities or with the Department of Mines and Technical Surveys. It would be more logical to gather into the Dominion Observatories all federal work in astronomy and its closely related fields. This would require transferring to the Branch the radio-telescope facilities now maintained by the National Research Council and the Defence Research Board. The network of astronomical observatories thus created would form a logical administrative and scientific group.

14 *We therefore recommend that:*

All federal astronomical research be consolidated in the Dominion Observatories Branch, which should become a national institute of astronomy within the National Research Council.

SPACE RESEARCH

15 Space research is intimately related to a wide range of other topics. Astronomy, aeronautics, and meteorology are obvious examples; and there are certain subjects connected not with outer space but with the upper atmosphere which are nevertheless classed as space research. Space research does not appear in the Estimates as a distinct item, but it is in fact being carried on in a number of government laboratories. The

most important of these are in the Defence Research Board, the National Research Council and the Department of Transport.

16 It has been estimated that the non-military content of the above research involves directly some seventy people at a cost of about \$2 million a year. Slightly less than half the research depends upon the use of the rocket-launching facility at Churchill, Manitoba, built by the United States Army as a contribution to the International Geophysical Year. Liaison has been difficult because of the divided responsibility for rocket launching and scientific research. It has been suggested that the new launching facility be operated by Canada, and that the National Research Council assume responsibility for it. Research in upper atmosphere and space physics is widely dispersed in departments and agencies and has suffered from the lack of a Canadian rocket facility. Should it be government policy to expand this research, Canada should take over the rocket-launching facilities at Churchill.

17 The Radio and Electrical Engineering Division of the National Research Council conducts a substantial amount of defence research which grew out of wartime work on radar. This defence research should be transferred to the Defence Research Board. With the advent of satellite communications and the necessity for radio control of rockets and for data telemetry, it is difficult to separate modern communications problems from space research. Space and Telecommunications Research would be a suitable major programme to succeed defence research in the Radio and Electrical Engineering Division. All non-military space and telecommunications research could be transferred to the Radio and Electrical Engineering Division of the National Research Council. This Division should be made responsible for the scientific operation of the Churchill rocket-launching facility. The research should comprise:

- All upper atmosphere research conducted by the Defence Research Board which is not of direct significance to defence, whether or not it involves the use of rockets.
- All upper atmosphere and satellite research now conducted in other divisions of the National Research Council, for example that on cosmic rays.
- The research now conducted in the Radio and Electrical Engineering Division on meteors and satellites and the operation of Minitrack instrumentation.
- Research on satellite communications on behalf of the Department of Transport, which should not be encouraged to set up its own facilities.

OCEANOGRAPHY

18 Before 1962, a number of government and other agencies had direct or indirect interest in oceanography. They kept in touch with one another through an informal Canadian Joint Committee on Oceanography, which included representation of all government agencies active in the field and of the universities that have departments of oceanography or related subjects. Increasing interest in Canada and abroad, together with the creation of official international organizations, made a more formal arrangement desirable. A major reorganization of federal government oceanographic activities was instituted on April 1st, 1962. The new arrangement had to take into account the following Canadian interests:

- *Defence*, particularly naval interest in anti-submarine warfare, and work of the Defence Research Board.
- *Fisheries*, including the Fisheries Research Board, concerned especially with marine biology.
- *Hydrography*, represented by the Department of Mines and Technical Surveys, and

including the study of tides and currents, as well as charting.

- *Transport*, including several agencies in both Marine and Air Services.
- *The National Research Council*, with a variety of interests, including marine model studies.
- *Several universities*, notably British Columbia, Toronto, and Dalhousie.
- *Other groups* interested in such related topics as disposal of atomic waste, oil pollution, the study of submarine geology, and observations and forecasting of sea-ice.

19 From this diversity of interests and variety of organizational forms a new pattern was evolved. The system now in effect divides official responsibility for oceanography within the government between two main agencies, leaving certain additional subsidiary interests intact. The two main groups are the Department of Mines and Technical Surveys, which established a new branch to include both hydrographic surveying and physical oceanography and takes care of certain defence requirements, and the Fisheries Research Board, which is largely responsible for marine biology.

20 Other interests remain much as before, except for a strengthening of university work made possible by government assistance. A reasonably clear definition of the responsibilities of the different agencies has been prepared.

21 The Canadian Committee on Oceanography serves as a co-ordinating body, representing government and university organizations actively engaged in the work, and also advises the government on international oceanographic matters. Working groups on oceanography have been established on the east and west coasts of Canada, and on the Great Lakes.

22 A number of major new undertakings have been started which increase the capacity of Canadian oceanography to meet the demands being placed on it, both nationally and internationally. An oceanographic research institute is being built near Halifax, both to house physical oceanography research, largely under the auspices of Mines and Technical Surveys and the Fisheries Research Board, and to serve as a base for hydrographic activities and as regional headquarters for marine sciences. It will be administered by the Department of Mines and Technical Surveys. A similar station will eventually be built on the west coast. Aid to universities is being increased to enable them to carry on research and instruction in oceanography with a view to increasing the flow of trained scientists to government services.

23 The integration now taking place will bring problems which need intensive study. Integration, within the Department of Mines and Technical Surveys, of the traditionally distinct fields of hydrography and oceanography will require joint use of vessels and the gradual blending of personnel with distinct traditions. The hydrographic profession has, traditionally, been non-scientific, and university training has not been a normal qualification for it. Within the government service there is a growing separation of physical and biological oceanography. This is inherent in the division of labour between the Fisheries Research Board and the Department of Mines and Technical Surveys, which may make the work of university oceanographers more difficult, since it divides administratively what is to them a unified field.

24 There may be a relative weakening of non-governmental influence on the Canadian Committee on Oceanography and particularly on the Fisheries Research Board, due in part to the expansion of government activ-

ities and the overwhelming importance of government finance. Strengthening of university work and representation is vital to meet the great demand for new recruits to the profession.

25 The separation of physical oceanography and marine biology on the east coast (the one at Halifax and the other at St. Andrews) merits study. A similar division may arise on the west coast should a new oceanographic institute be built there. On scientific and related grounds, there is now little to commend the location of the marine biological institute at St. Andrews, New Brunswick. It could be transferred to the site of the oceanographic station at Halifax.

26 The Department of Mines and Technical Surveys is responsible for Arctic oceanography. This includes parts of the polar basin and the channels linking it with southern Canada. The Polar Continental Shelf Project has for the past three years contributed useful data on summer conditions, but no organization yet exists for securing corresponding information during winter.

AERONAUTICS

27 Although aeronautical research has a long and honoured tradition in Canada, dating from the early years of the present century, it was not until the period 1939-50 that the Canadian government first established aeronautical research facilities, within the Mechanical Engineering Division of the National Research Council. In 1950, due to the rapid development of aeronautical science and technology, and to Canada's interest in setting up aircraft development and production facilities in connection with defence requirements, the Cabinet authorized the creation of the National Aeronautical Establishment. Its terms of reference were: "The National Aeronautical Establishment will comprise laboratories and flight test

facilities for the conduct of research and experiments required for the development and operation of military and civil aircraft in Canada."

28 To co-ordinate the work of the National Aeronautical Establishment, the National Aeronautical Research Committee was set up, which reports to a sub-committee of the Privy Council Committee on Scientific and Industrial Research, as indicated in Chart 8. A Technical Advisory Panel was also established to advise the National Aeronautical Research Committee.

Organization

29 Chart 8 shows the general organization for aeronautical research and the relationships of the various interested units. It demonstrates that the National Aeronautical Establishment is essentially under dual control. The National Aeronautical Research Committee is responsible for matters of broad policy concerning the functioning of the establishment, while the Director is responsible to the President of the National Research Council for matters related to administration. This arrangement reflects the essentially interdepartmental and interagency character of the National Aeronautical Research Committee, the members of which are the Chairman of the Defence Research Board, the President of the National Research Council, the Chief of the Air Staff, and the Deputy Ministers of Defence Production and Transport. The membership of the Technical Advisory Panel is likewise broadly based.

30 Of continuing importance is the role of the National Research Council's Associate Committees concerned with aeronautics. These were set up to enable experts from the government service, the universities, and industry to discuss technical problems of mutual interest. They were never intended to advise on research and development programmes—this is the *raison d'être* for the Technical Advisory Panel.

31 Responsibility for the essentially defence aspects of aeronautical research rests with the Defence Research Board. Some important areas of aeronautical research are being investigated at the Canadian Army Research and Development Establishment, more particularly in the field of re-entry physics and the development of associated hypersonic range facilities. The Institute of Aerophysics, University of Toronto, which has been partially supported by the Defence Research Board, is recognized as an international laboratory for basic research in aerophysics. The Defence Research Board does not have extensive aeronautical laboratory or test facilities at its disposal, and use is made of the facilities of the Aeronautical Establishment, with which there is close co-operation.

32 The Directorate of Engineering Research (Defence Research Board) is responsible, among other activities, for monitoring Armed Services development contracts in aeronautical engineering, and for the development of special types of aircraft, such as vertical-take-off and short-take-off aircraft. However, the major responsibility for military aircraft development rests with the Directorate of Aircraft Engineering, RCAF. This directorate is one of four reporting to the Chief of Aeronautical Engineering. It is responsible for developing aircraft to the stage when flight tests are carried out and accordingly works in close association with the aircraft industry. At present, the professional staff totals only eighteen officers.

33 The Mechanical Engineering Division of the National Research Council is responsible for the propulsion aspects of aeronautical engineering.

34 The major expenditures involved in the creation of the National Aeronautical Establishment have arisen in connection with the 5-foot transonic-supersonic wind tunnel under construction at Uplands Airport.

Chart 8—AERONAUTICAL RESEARCH ORGANIZATION

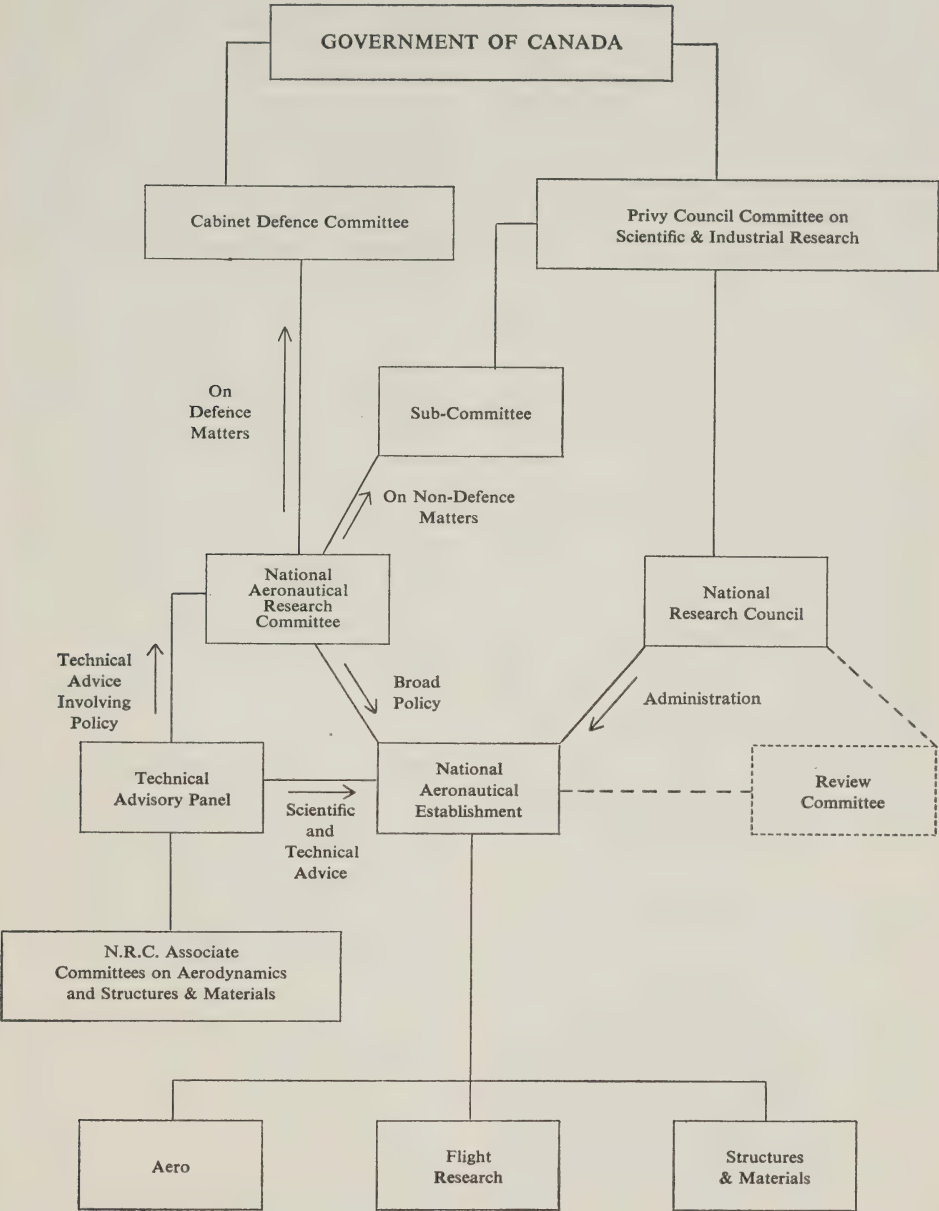


Table 4—APPROXIMATE DISTRIBUTION OF NATIONAL AERONAUTICAL ESTABLISHMENT PROFESSIONAL AND TECHNICAL STAFF AMONG SECTIONS 1959-61

<i>Section</i>	<i>1959-60</i>	<i>1960-61</i>	<i>1961-62</i>
Aerodynamics	53	69	79
Flight Research	40	43	49
Structures	35	37	41
Service	16	15	15
Administration	3	3	3

Table 5—OPERATING BUDGETS OF THE NATIONAL AERONAUTICAL ESTABLISHMENT 1960-62

	<i>Salaries</i>	<i>Operations and Travel</i>	<i>Total</i>
	\$	\$	\$
1960-61	1,002,000	344,000	1,346,000
1961-62 (estimated)	1,105,000	428,000	1,533,000

Although the National Research Council is the design authority and is responsible for the construction of the wind tunnel, the costs have been shared almost equally with the Defence Research Board. The fact that the Aerodynamics Section has at present the largest group of personnel is directly related to the building of the wind tunnel.

National Aeronautical Establishment Programme

35 The National Aeronautical Establishment programme is co-ordinated to a certain extent with the aeronautical research of the NATO nations through the NATO Advisory Group for Aeronautical Research and Development; close relations with nations of the British Commonwealth are maintained through the Commonwealth Advisory Aeronautical Research Council.

36 Although the 5-foot wind tunnel is the chief government aeronautical development

project in hand, it is usually considered independently of the current National Aeronautical Establishment programme. Total expenditures to date have been approximately \$9 million and the project has suffered from lack of co-ordination; at the time of review the tunnel was still not in operation after ten years' work, although similar facilities have been established in the United States in three to four years and at less cost. A detailed study of the wind tunnel project is beyond the scope of this Commission but nonetheless merits attention.

37 Several other topics are being investigated by the Establishment. The Aerodynamics Section is studying the aerodynamics of vertical take-off and landing; heat transfer problems in hypersonic flight; boundary layers, configuration optimization, and flutter research programmes in preparation for the 5-foot wind tunnel; and extension of the hypersonic work to include plasma jets and magneto-gas dynamics. The Structures Section is studying problems in structural analysis, dynamic plasticity, fatigue, non-metallic engineering materials, structural stability, and kinetic heating. The Flight Research Laboratory, which depends for its flight facilities (both men and machines) on the RCAF, is studying thrust augmentation, control systems for low-speed and hovering flight, slip-stream deflection and high lift devices applicable to vertical-take-off and landing and short-take-off and landing aircraft, stability, precipitation physics, air loads, and airborne magnetometry.

Programmes of Division of Mechanical Engineering (National Research Council)

38 Aeronautical research is carried out in the Gas Dynamics, Instrument, Low Temperature, and Engine Sections of the Division. Current activities include investigation of the behaviour of the vertical-take-off and landing fan, with special reference to the measurement of power, efficiency and air-

flow; experiments on vertical-take-off and landing aircraft models; control systems for the supersonic wind tunnel; aircraft noise; and air traffic control.

Programmes of the Directorate of Aircraft Engineering, RCAF

39 The work of this Directorate is closely associated with industrial programmes. Its responsibilities include modification of the CF 104 and CK 109 aircraft to Canadian requirements, development of the CC 106 transport aircraft, and special studies, including airworthiness.

40 In view of the fact that the total professional staff of the Directorate is only eighteen officers, of whom fourteen have professional engineering qualifications (four have higher degrees), it is clear that the development programmes can only be dealt with superficially, and it would be more appropriate to regard the Directorate as being responsible for specification rather than development work. For example, the design of a single military aircraft usually involves more than 100,000 professional man-hours.

Programmes of the Directorate of Engineering Research (Defence Research Board)

41 The programme of this Directorate, which is closely concerned with technological aspects of the Department of Defence Production development-sharing programme, is carried out in collaboration with industry and the universities. The six professionals in the directorate handle, in addition to aeronautics research and development programmes, such matters as hydrofoil development and land-vehicle mobility; the results achieved to date constitute a praiseworthy effort.

42 For example, the development of the Caribou aircraft has benefitted from encouragement by the Directorate. A large number of these aircraft are being exported

to the United States and other countries. This project exemplifies the importance of pursuing development projects, especially novel ones, to their conclusion.

43 The major portion of the aeronautical research and development programme is concerned chiefly with the development of new propulsion units for short-take-off and landing and vertical-take-off and landing aircraft, and with the structure of these aircraft.

Co-ordination of Aeronautical Research and Development

44 The National Aeronautical Research Committee is the senior body in Canada for the formulation of government aeronautical research and development policy. However, when it was established in 1950, it was regarded essentially as the parent body of the National Aeronautical Establishment. The subsequent activities of the Technical Advisory Panel, the chief scientific advisory panel to the Committee, were concerned largely with the programme of the National Aeronautical Establishment. Moreover, the official organization chart implies that the Committee and the Panel are concerned solely with National Aeronautical Establishment affairs, to the exclusion of other government-sponsored programmes in aeronautical science and engineering.

45 Thus, although the National Aeronautical Research Committee is responsible for the formulation of policy for the National Aeronautical Establishment, there appears to be no single body for the co-ordination of the aeronautical research and development programmes carried out by, or sponsored by, the Defence Research Board, the RCAF, the Department of Defence Production, the Department of Transport and the National Research Council.

46 There is a small measure of co-ordination of programmes between, for example,

the RCAF Directorate of Aeronautical Engineering and the Defence Research Board Directorate of Engineering Research, through the medium of the Technical Advisory Panel. However, in practice, the Defence Research Board Directorate does not give advice to the RCAF in connection with aircraft development problems. Nor are the vertical-take-off and landing and short-take-off and landing programmes (supported by the Department of Defence Production, with the assistance of the Defence Research Board) co-ordinated effectively with similar programmes being undertaken by the National Aeronautical Establishment.

47 Your Commissioners see no justification for two large-scale government aeronautical establishments, one civil and one military. The National Aeronautical Establishment should suffice to handle both defence and civil programmes. If, as recommended in Part 1, the responsibility for all defence development programmes is vested in the Defence Research Board, the problem of co-ordinating the defence and civil aeronau-

tical research programmes would be simplified. The National Aeronautical Research Committee is responsible for the formulation of policy and the co-ordination of government aeronautical research activities in Canada, and it should assume responsibility for co-ordinating the programmes of the Defence Research Board, the RCAF and the Department of Defence Production in this field.

48 The recent expansion in the membership of the Technical Advisory Panel to include two members from industry should serve to minimize, in the future, the possibility of comparatively large-scale aeronautical development programmes getting out of control. The Panel will also serve as a focus for the co-ordination of national programmes. The future collaboration between the National Aeronautics Establishment and the Canadian aircraft industry is considered to be of great importance, and it should be high on the list for discussion by the re-vitalized Technical Advisory Panel.

6

DEPARTMENTAL RESEARCH OF COMMON INTEREST

1 Several areas of research are of interest to more than one department. Some of these, discussed in the preceding chapter are not essentially related to operational activities, and accordingly it was recommended that they be consolidated within the framework of an enlarged National Research Council.

2 The research areas discussed in this chapter are related to departmental operations: the Polar Continental Shelf Project, Northern Research, and Ice Research. The first represents the best solution yet found to minimize duplication of departmental effort, and to take advantage of common services and a co-ordinated approach. There is no doubt that in future years more and more research programmes will require co-operation of several departments and agencies. It is essential that means be developed to prevent the waste and duplication now current in such programmes. No master plan suitable in every case is proposed in this chapter. Rather, in the context of each programme, suggestions are made which seem most suitable in the circumstances. Certain principles common to all such undertakings emerge.

POLAR CONTINENTAL SHELF PROJECT

3 This Project was organized to carry out a programme of survey and scientific research in the area of the continental shelf of the Arctic Ocean adjacent to and within Canada. In practice, the work has extended to some of the Queen Elizabeth Islands and shows evidence of expanding southward toward the mainland. The need for it arose in part from the United Nations Conference on Laws of the Sea in 1958, which allocated minerals within the continental shelf to the adjacent state, and in part from the lack of any detailed study of the northern continental shelf. It was decided to prepare a programme which would include all aspects of technical survey and research in the physical sciences within a single co-ordinated project. A steering committee was set up within the Department of Mines and Technical Surveys and a Co-ordinator appointed. The first summer field season was in 1959, and the work continues.

4 The organization is flexible. During 1961 a total of about seventy persons were active on the Project, including twelve scientists

seconded from other agencies. It is expected that the permanent staff will remain small, and that the scientific staff will vary in size and character as the programme itself changes. The total cost attributable directly to the Project for the year 1961-62 is estimated at \$1,572,000. Two university projects operating in the same general areas have received some assistance.

5 There has not been a continuous programme in all fields. The intention is to initiate programmes that appear necessary and terminate them when adequately covered. In this way there will be a continual change of emphasis. In 1961 programmes in progress concerned oceanography, hydrography, submarine geology, topographical surveying, aeromagnetic surveying, geomagnetism, seismic and gravity surveying, glaciology, geomorphology, and sea-ice studies. If it is shown that a long-term routine programme is justified, the present view is that this programme may eventually be assigned to a department.

6 The essential difference between this project and the traditional surveys of the various departments is that it is centrally planned and organized. There is a single headquarters and a single logistic and supply service. Scientists from various disciplines have been compelled by local circumstances to work together in the field, and to become familiar with each other's techniques and results. This interdisciplinary approach has obvious scientific advantages.

7 Nevertheless, there may be continuing problems due to the traditionally rigid division between scientific and technical disciplines. For example, the Geological Survey and the Hydrographic Survey have for decades been accustomed to working as distinct, closely knit units. As such they have planned their own field or office operations entirely independently, and publicity concerning the

work has been harvested by the individual unit. Clearly such luxuries are not possible under the new arrangement. It is still uncertain whether the common interest in economy of operation, and the flexibility of programmes and staffing arrangements, can overcome the very strong departmental tradition of independence.

8 Because the Project, in its conception, staffing and administration, runs counter to strongly entrenched departmental and branch autonomy, a firm policy will be required to prevent it being taken over by the stronger of the existing branches of Mines and Technical Surveys. At present it is attached to the office of the Director-General for Scientific Services and will continue to need some such association to provide the necessary authority and independence.

ICE STUDIES

9 Study of ice is now of major scientific concern in Canada due to greatly increased activity in the far north in summer, the extension of winter navigation in eastern Canada, the need to understand the *régimes* of glacier-fed rivers in the west, and a general increase in interest in all aspects of the Canadian natural environment.

10 Ice studies carried on in Canada are of two main types: those concerned with ice in navigable waterways, and with ice on land. Several agencies have become interested in the scientific study of ice since World War II, and there has been a notable increase in the extent of the work during the past decade. Some co-ordination is provided by the Canadian Committee on Oceanography Working Group on Ice in Navigable Waters, and by a sub-section of the National Research Council Associate Committee on Geodesy and Geophysics that deals with glaciology. The main areas of interest and the active agencies are:

Ice in Navigable Waterways:

- Navigation—Royal Canadian Navy, Department of Transport (Marine Services), and private shipping interests.
- Fishing, sealing—Fisheries Research Board, and some provinces.
- Defence—Defence Research Board, RCAF, and other Services.
- Observation and forecasting for navigation—Department of Transport (Meteorological Branch and Marine Operations), Department of Mines and Technical Surveys (Geographical Branch).
- Origin and distribution of sea ice—Mines and Technical Surveys (Oceanographic Division and Geographical Branch).
- Historical distribution of sea ice and factors responsible for it—Department of Mines and Technical Surveys (Geographical Branch).

Land Ice:

- As a source of irrigation and industrial water—Department of Northern Affairs and National Resources (Water Resources Branch).
- Glaciology—Department of Mines and Technical Surveys (Geographical Branch).
- Building and related problems and foundation studies, including permafrost—National Research Council (Building Research Division).

11 Knowledge of the origins, distribution, movements and decay of ice in the sea is of great practical significance to navigation in Canadian waters, but continued improvement in this knowledge is impossible without basic research. Canada should be a major contributor to ice research but has not been in the past, largely because of a lack of a carefully

planned and generally accepted research programme in the federal government; absence of agreement within the government on areas of responsibility; shortage of qualified scientists; and inadequacy of university training facilities. The few qualified ice scientists available have been scattered through several agencies and have worked without co-ordination. For example, the National Research Council Division of Building Research has for many years carried on a programme under its Snow and Ice Section and another under its Northern Building Section. Scientists with similar training and interests have been at work in the Geographical Branch of the Department of Mines and Technical Surveys, the Geological Survey of Canada, and the Defence Research Board. Most of the field glaciology, as well as glacial morphology and periglacial studies, have been carried out by the Geographical Branch. In recent years the Water Resources Branch of the Department of Northern Affairs and National Resources has carried on a glacier survey programme.

12 Study of ice in seas and lakes is of interest to many agencies, so that the danger of duplication and wasted effort is great. For example, some observation of sea-ice is undertaken by a unit of the Meteorological Branch of the Department of Transport, some by the same Department's Marine Operations Branch, and some by the Geographical Branch of the Department of Mines and Technical Surveys, although for different purposes. Research on the origins and distribution of sea-ice is of interest to the Meteorological Branch, the Geographical Branch, the Division of Oceanography of the Department of Mines and Technical Surveys, the Defence Research Board, and some others.

13 Large expenditures of public funds have been made to charter aircraft for ice observation. Some at least of this expensive direct observation could be avoided if the reasons

behind the changing distribution of sea-ice were understood; this can only be achieved as a result of basic research. Ice observation is not a routine matter, and techniques are not yet exact; in fact, considerable criticism has resulted from its imperfections in eastern Canadian waters in recent years. Ice distribution forecasts are said to be even less dependable.

14 The cause of these deficiencies is not hard to trace. Ice observation was first undertaken by the Meteorological Branch about five years ago without extensive experience or well qualified personnel. The whole undertaking still carries too many signs of being an *ad hoc* appendage to an otherwise efficient meteorological service. Training in meteorology provides little or no qualification for ice observation and forecasting. Most of the meteorological ice observers are technicians with little understanding of the complex problems of ice navigation. Better qualified oceanographers have not been actively interested until recently, and they are still few in number. The only government agency with long-term experience (about ten years) is the Geographical Branch. It has published a series of annual reports on ice conditions in the Arctic and the Gulf of St. Lawrence which have been well received by those planning commercial navigation in ice-filled waters. However, the Branch has been chronically short of qualified personnel in this field.

15 Sea-ice studies in the Canadian eastern Arctic and off the Atlantic coast should logically be closely co-ordinated with those conducted by Denmark in Greenland waters. Canadian scientists should also be familiar with the long-term research of Soviet scientists into the movement of polar ice, both within the polar basin itself and in the adjacent seas.

16 Increased interest in Canada in the science of hydrology has led to initiation of long-term studies of glaciers that contribute

to stream flow in the mountains of Alberta and British Columbia. This is a matter of special interest to the western prairies. There is need to ensure the maximum of concentrated effort by available government scientists and a minimum of overlapping by several agencies.

Future Policy

17 To avoid duplication of effort and the consequent waste of personnel and finances, it will be necessary to correlate the work of all government agencies concerned with ice studies. This responsibility should be assigned to the proposed Central Scientific Bureau. In the various fields of study, specific responsibilities should be assigned.

18 The Geographical Branch of the Department of Mines and Technical Surveys should be recognized as the centre for glaciological research in the federal government. The limited work in this respect now carried on by the Geophysical Research Section of the Directorate of Physical Research, Defence Research Board, should be transferred to the Geographical Branch.

19 Research concerning ice in seas, lakes and rivers can, under present circumstances, best be undertaken through a division of responsibility as follows:

- Observation of ice distribution for tactical support of ships, the plotting of the data on maps, and short-term forecasting, at present in part a responsibility of the Meteorological Branch, Department of Transport, should probably be a responsibility of the Marine Operations Branch of that Department, since it is in direct contact with those using the information. Improvements are needed in the system of gathering and disseminating the information, since speed is essential. The continual shortage of meteorologists and technicians in the Meteorological Branch suggests that this agency should be relieved from a

growing burden of ice observation and forecasting.

- Analysis of ice distribution over longer periods, and the preparation of longer-term forecasts, which involve a more profound study of the physical forces at work, should be a responsibility of the Oceanography Institute at Halifax. Meteorologists from the present Halifax Ice Centre or elsewhere should be seconded there if needed. It should be the centre for government research into the factors influencing the origin, distribution and decay of sea-ice.
- Historical studies of ice distribution based on past records and on those secured from the Marine Operations Branch and the Oceanography Institute, with the recording function, should remain a responsibility of the Geographical Branch. For these purposes, periodical ice reconnaissance flights should be undertaken to record the state of the ice at specific times of the year and at specified locations, as part of a long-term study. Annual reports on sea-ice distribution in Canada should be produced by this Branch.

20 As in the past, fundamental ice research should be carried on at universities, aided by government grants. It should be closely co-ordinated with similar work in the National Research Council, but expansion in ice research should preferably take place at universities.

21 Ice observation and forecasting, and the study of its origins, are obviously best carried out in close relationship with other countries. Hence, emphasis should be laid on international co-operation in ice research and in the allocation of different spheres of scientific interest to the various countries concerned.

NORTHERN RESEARCH AND DEVELOPMENT

22 Research in northern Canada is carried on by several departments and agencies of

the federal government, and by private organizations and individuals.

23 There is no agreed division of responsibility for scientific research between the Department of Northern Affairs and National Resources and other federal departments and agencies, and applications by the former for major research funds have been rejected because the National Research Council and other agencies were more appropriate.

24 Non-governmental research has a long history in the north. Individuals and university groups, both Canadian and foreign, as well as such organizations as the Arctic Institute of North America, have been active. An increasing proportion of funds for such work has come from government sources, some from the United States.

25 Since World War II federal departments and agencies have greatly expanded their scientific activities in the north. Among them are the Department of Mines and Technical Surveys (which has long had an interest), the Fisheries Research Board, the Defence Research Board, the National Research Council, the Department of Transport, and even the Department of Agriculture, whose far-ranging botanists have reached the shores of the Polar Sea. So diverse are these undertakings, and so tangled their lines of administrative responsibility, that nowhere could your Commissioners find a fully comprehensive report on their character, extent, use of manpower and total expenditure.

26 While all scientific departments have some interest in the north, Northern Affairs and National Resources has general and special interests, and its responsibilities must be borne in mind in any assessment of the research roles of government departments in the north.

Research Programmes

27 Apart from the Northern Co-ordination

and Research Centre, which carries on little direct research, two units of the Department of Northern Affairs and National Resources engage in some northern research. These are the National Museum and the Canadian Wildlife Service, whose programmes have been described. In addition, the Water Resources Branch may be expected to extend its general programme to the north at an increasing rate. It is commonly believed that the Northern Administration Branch does no research. In fact, some activities of the Industrial, Engineering, and Resources Divisions can be considered as research or development. Projects are of two main types: those directed to the solution of technical problems, for example housing and other construction, techniques for processing natural products, and surveys directed at community development; and studies in the social sciences made with a view to solving social problems.

28 No central records are maintained concerning northern research by other agencies except for a listing of permits issued to "scientists and explorers", and these are not required of government parties. Since detailed research data are not available, it is difficult to assess its extent, effectiveness, degree of co-ordination, economy of operation and general adequacy. From what is known, the research falls into the following main categories:

- Extension to the north of types of research long carried on in southern Canada by the Departments of Mines and Technical Surveys (Geological Survey, Dominion Observatories, Geographical Branch, et cetera), Transport (Meteorology), and Agriculture (Entomology and Botany), and by the National Museum (diverse sciences) and the National Research Council.
- Specific tasks related to economic or social developments, for example Department of Northern Affairs (regional planning, resources studies).

- Research of the type sponsored by the Arctic Institute (Devon Island research station), Defence Research Board (Lake Hazen Station), McGill University (Axel Heiberg Station), Northern Research and Co-ordination Centre, and smaller-scale undertakings by individuals.
- Co-ordinated area projects, of which the main example so far has been the Polar Continental Shelf Project.

29 Many agencies are at work independently and when several concentrate at one place there is a scientific research complex, which could be treated as a station or centre. Experience at Resolute Bay, where a variety of scientific work has been carried on since 1947, is illuminating. In October, 1961, when all summer activities of a temporary character had ended, the following Canadian government civilian agencies were engaged there in scientific work:

- Department of Transport—
 meteorological observations
 ozone research
 ice measurement
 temperature measurement at depth
 telecommunications
- Defence Research Board—
 telecommunications
 back scatter
 oblique incidence
 topside sounder
- National Research Council—
 cosmic rays
 Aurora studies
 spectrometer
 snow studies
- Department of Mines and
 Technical Surveys—
 seismology
 magnetism
 tidal gauging

30 This obviously represents a comprehensive programme of geophysical research.

While the projects may not be competitive with each other, there is no evidence that they are parts of a unified and systematic inquiry, or that they are even co-ordinated logistically.

Inter-departmental Co-ordination

31 Co-ordination of the multifarious northern scientific programmes is in theory the responsibility of the Department of Northern Affairs and National Resources. The Advisory Committee on Northern Development has the following terms of reference:

To advise the government on questions of policy relating to civilian and military undertakings in northern Canada and to provide for the effective co-ordination of all government activities in that area.

32 This Committee, under the chairmanship of the Deputy Minister of Northern Affairs and National Resources, consists of all Deputy Ministers and other equivalent officials whose departments are active in the north. The Committee maintains a small secretariat headed by a senior official of the Department of Northern Affairs and National Resources. Much of its work is done through a series of sub-committees dealing with transport, communications, construction, and scientific research.

33 The Scientific Research Sub-committee was formed in 1959 and has been relatively active. It has discussed major proposals concerning northern research, for example the plans to build and operate a scientific station at Inuvik near the mouth of the Mackenzie River. It has recommended grants to research organizations, such as the Arctic Institute. The Research Sub-committee does not, however, control routine scientific work conducted in the north by government departments, and has no authority to review budgets or other proposed expenditures on research.

34 The whole committee structure is advisory and lies outside the normal lines of

administrative and financial responsibility passing from the departments through their ministers to the Cabinet. It consists of staff members of departments, whose first loyalty is to their own organizations. Such a committee system may be useful as a clearing house for information on forthcoming research. It can even provide a service by supporting the plans of a unit wishing to secure funds from the Treasury Board. What it cannot do is restrict the ambitions of its own members, or compel them to integrate their activities in the interests of long-term scientific planning, conservation of manpower, or economy of public funds.

Northern Co-ordination and Research Centre

35 The Centre was founded in 1954 to undertake research on northern subjects, to encourage northern research by non-government agencies, to co-ordinate departmental and interdepartmental northern research, and to collect and disseminate technical and scientific information on the north. The Centre reports through the Secretary of the Advisory Committee on Northern Research to the Deputy Minister of the Department. The total staff of sixteen includes personnel both of the Centre proper and of the Committee secretariat.

36 The Centre specifically has the obligation "to co-ordinate departmental and interdepartmental research in the north. . . ." Had it been able to fulfil its co-ordinating role effectively, many current difficulties might have been avoided. The Centre has failed to meet expectations for several reasons:

- It received neither adequate funds nor sufficient personnel.
- Other agencies have preferred to develop their own facilities, for which funds and personnel have apparently been available.
- Neither government agencies nor the interested public have, to any considerable

extent, turned to the Centre for information, and it has not become the source of specialized information.

- The Centre's authority to undertake research itself, though circumscribed, has raised the fear among departments that it would compete with them in their own special fields.
- Little has been done to encourage non-government agencies to undertake research in the north.

37 The Centre has not been entirely unsuccessful. It exists as a possible nucleus of a much more effective organization, and has meanwhile maintained a departmental northern library and dispensed a small research fund, mainly in the field of anthropology, although in almost every case the topics selected could have been dealt with by another research unit of the government.

Re-organization of Northern Research

38 The present organization of northern research is clearly unsatisfactory. Most research to date has concerned the natural sciences, and has been generally limited to collection and correlation of data. There has been no serious attempt to plan an overall unified campaign, except for topographic and other mapping, including geology and some aspects of geophysics. In these cases the separate agencies directly concerned have made their own long-term or seasonal plans.

39 Until recently there has been relative neglect of the social sciences. Studies related to administrative planning, to the adaptation of the native peoples to changing conditions, to the effect of government and other policies upon the lives of such people, are now beginning to receive attention. It has become apparent, though, that qualified and experienced scientists are rare in these fields.

40 There are at present several ways in

which northern research can be carried out. They are:

- Through the separate federal departments or agencies as a routine extension of work being undertaken in the south.
- By the Department of Northern Affairs and National Resources, because of its special responsibility for activities in the territories.
- Through some form of interdepartmental body; the Polar Continental Shelf Project is an example, although administered from the Department of Mines and Technical Surveys.
- By non-government organizations, such as universities or the Arctic Institute.

Whatever organization may be employed to undertake research in the north, a substantial portion of the costs will have to be borne from public funds.

41 In the past decade, the tendency has been for departments to expand their facilities and staffs in order to undertake large-scale northern research programmes. This is particularly true of the Departments of Mines and Technical Surveys, Transport, and Fisheries, but less so, as yet, of Forestry and Agriculture. A compelling factor driving departments northward is that in the provinces they survey resources on sufferance, for the *British North America Act* gives them no authority to do so. In the territories, federal writ is still effective. This tendency to run riot in the north was foreseen in the late 1940's, and an effort was made to stem it, first, as part of a general policy not restricted to research, through the medium of the Advisory Committee on Northern Development, and later through the Northern Co-ordination and Research Centre. In effect the Committee has been used by departments wishing to secure support for a particular policy or project before submitting it to the Treasury Board, but ignored when it seemed

likely to co-ordinate or curtail their own independent plans. In any event the Committee—and still more the Centre—lacks the necessary authority to make its views effective.

42 Such interdepartmental co-ordination as takes place is largely on a voluntary basis. Even when the Advisory Committee on Northern Development has approved a proposal, there is no assurance of success unless a particular department is prepared to provide the funds. On the other hand, a department can undertake northern research without raising the matter at any co-ordinating committee, so long as it can secure the funds from the Treasury Board, which has lacked disinterested advice on the best policies to follow in granting funds for northern research. As in other areas, the result has been that those departments able to make the most forceful submissions have been the most successful.

43 Thus there is nothing to encourage interdepartmental projects, and no mechanism is provided for assuring that an appreciable amount of northern research is done by non-governmental organizations. Nor is there the means for training the scientists needed to do the work—either inside the government agencies or elsewhere. Apart from the National Research Council grants, little or no public money for the purpose has passed from departments to universities or other research groups, even during recent years when northern research expenditures have increased enormously.

44 A system of departmental control of northern research has not led to the establishment of well-balanced permanent research centres anywhere in the north, although plans were approved in 1962 for a scientific station at Inuvik, where laboratories and other facilities are to be available to all departments and possibly to independent scientists. A grouping of separate research projects exists in a

few places, but with no facilities for the unaffiliated scientist. The only truly interdisciplinary stations that exist have been built through private initiative, with the exception of the Defence Research Board International Geophysical Year centre at Lake Hazen, which was staffed largely from outside the government.

Conclusions

45 The present system is wasteful of money and personnel and does little to ensure that necessary research is being carried out. Certain conclusions are evident.

- Co-ordination of scientific work in the north and the determination of priorities should be the concern of the proposed Central Scientific Bureau.
- The Department of Northern Affairs and National Resources should not itself undertake scientific research in the north (assuming, of course, that the National Museum, Canadian Wildlife Service and Water Resources Branch are transferred elsewhere). The research needs of this Department can best be met by arranging for the work to be done by the appropriate department, or by securing on temporary secondment the services of scientists needed for specific tasks; an example would be the study of the economic geology of Arctic petroleum reserves, for which task the Department of Mines and Technical Surveys is equipped. Non-government research should be actively encouraged.
- Centrally administered northern research facilities would permit the greatest possible common use. These facilities, including scientific stations and permanent research stations, represent heavy costs in construction and maintenance and should be located to serve general interests rather than those of a single agency. It would be logical to assign the responsibility for administering such facilities to the Department of Northern Affairs and National

Resources. Its role should be one of service but not control, although it should be a requirement that the various departments and agencies make use of these services.

46 *We therefore recommend that:*

- 1 The Department of Northern Affairs and National Resources

meet its northern research needs by contracting with other federal departments or private groups.

- 2 Facilities and services for research in the north be provided by the Department of Northern Affairs and National Resources.

7

THE PLACE OF INDUSTRY IN GOVERNMENT RESEARCH

1 In Part 1 of this report, attention is drawn to the small share of government research that has been allocated to private industry, a situation in striking contrast to that in Britain and the United States. Canadian government expenditures for research and development in industry are mainly concerned with defence and atomic energy. The federal government has recently inaugurated specific programmes designed to encourage industry to expand its own efforts in these fields and build up better facilities and larger research staff. These are outlined below.

2 The Department of Defence Production proposed support for a research and development programme in Canadian industry. It was recognized that Canada, a comparatively small country, faced special difficulties in trying to maintain an adequate defence industry in close partnership with the United States. A common policy on military operations and research, requiring integration of weapon development and production, had obviously curtailed the independent Canadian development of major military weapons systems. There was an urgent need to support

the development capability existing in Canadian industry but likely to be lost through the cancellation of development programmes. Planning was necessary for a long-term programme of industrial development to build up Canadian capacity to meet United States-Canadian defence requirements.

3 An inter-departmental committee (The Department of Defence Production Development Committee) was set up to administer the funds on the basis of recommendations from its Advisory Groups in the fields of aeronautics, electronics and weapons. The main emphasis has been placed on identifying specific United States military requirements that could be met from existing Canadian capabilities which are not now fully employed. Except for certain unique Canadian projects referred to below, long-term plans have been designed to enable Canadian industry to compete with United States industry for United States military requirements.

4 Canadian industry has had limited success in the face of United States competition

for military research projects financed from the United States. It is difficult to make a convincing story about ability to undertake research when the industry has no record of previous success in the field. Greatest success has come from projects originated and financed in Canada that were sure of adoption in the United States if they could be successfully developed. Projects now being financed jointly by the Department of Defence Production and industry include the Caribou and VTOL aircraft, airborne navigation instruments, rocket research, etcetera.

5 Even when it is agreed that development

of a United States military requirement is to be financed in Canada, procedural difficulties may sometimes remain. These include ownership and use of proprietary rights, monitoring of the project by United States authorities, security clearances, etcetera. However, the main difficulty has been to discover specific United States military requirements that can be dealt with by existing Canadian industrial facilities.

6 The status on November 30, 1961, of expenditures under Vote 72 to the Department of Defence Production is shown in Table 6.

Table 6—SUSTAINING TECHNOLOGICAL CAPABILITY—DEPARTMENT OF DEFENCE PRODUCTION VOTE 72

	No.	Programme		Actual Expenditures	
		1961-62	Future Years	Cumulative FY 1959-60 1960-61	FY 1961-62 to date
Awaiting Treasury Board approval in principle	1	\$ 10,000	\$ 29,750	—	—
Approved in principle by Treasury Board	7	475,000	5,920,000	—	—
Committed (DDP 85), Treasury Board authority to enter into contract, contract placed	43	8,465,067	7,556,748	\$ 4,752,775	\$ 1,432,219
TOTAL	51	\$ 8,950,067	\$13,506,498	\$ 4,752,775	\$ 1,432,219

7 In 1961 the Cabinet approved the establishment of an applied research fund, as part of a defence industrial research programme. The terms agreed upon were:

- that an industrial applied defence research programme be developed by the Department of National Defence in consultation with the Departments of Defence Production and Finance;
- that, subject to the programme thus developed, research areas and projects to be

supported be selected jointly by the Defence Research Board and the Department of Defence Production;

- that the specific applied research projects be recommended to Treasury Board for approval prior to contracts being placed with Canadian defence industry;
- that funds for this programme provided in Defence Research Board estimates be identified and accounted for separately from other expenditures of the Board.

8 Initially, the practice was that when a company requested support for a research programme, the merit of the proposal and the capacity of the company to undertake the task were assessed by the Defence Research Board in consultation with the Department of Defence Production and the Treasury Board; following this, financial arrangements were made through the Department of Defence Production, resulting in a contract. However, the contract procedure was found to be, in certain respects, inappropriate to this type of programme, and in the fall of 1962 it was decided that henceforth assistance would be provided by grants rather than contracts. As a result, Defence Production is now involved only in the assessment of proposals. The success of this new arrangement cannot yet be judged.

9 A third source of research funds for industry has been provided through the initiative of the National Research Council. In 1961, a statement was submitted to the Cabinet on the necessity for federal government assistance to industry for research and development. It was subsequently agreed that financial assistance be made available for research by industrial firms in Canada on the following basis:

- the assistance would be on a matching basis, with industry contributing at least half the cost of any project;
- the general purpose of the scheme would be to establish a number of competent research teams in industry each year over a period of years, and the research and development projects submitted by industry should be judged on their merits with this general purpose in mind;
- that a sum of \$1 million be provided for this purpose in the parliamentary grants to the National Research Council;
- that the programme be initiated by the National Research Council on an experimental basis after consultation with industry on matters of procedural detail;
- that decisions on the award of financial aid be made by committees competent in applied research and development and that, as necessary, the Council should establish committees of experts from departments or agencies of the government and from industry;
- and that rights arising out of the research projects would be the property of the company concerned.

8

THE INTERNATIONAL RELATIONS OF CANADIAN SCIENCE

1 The past fifteen years have seen an extraordinary growth of international science, in some cases through long-established organizations, in others through agencies of the United Nations such as UNESCO, and often by *ad hoc* arrangements set up to meet an immediate need, such as the International Geophysical Year.

2 Canada has, proportionately, carried an important share of the work involved. It has been host to many international meetings, and its scientists hold office in a diversity of organizations. Official delegations have attended numerous conferences (about one hundred invitations reach the Department of External Affairs each year), and many hundreds, possibly thousands, of other scientists in universities or industries have travelled abroad to attend conferences or to visit institutions and laboratories.

3 No formal organization exists to further these arrangements. Invitations may reach the government through diplomatic channels, or come direct to government departments or to the National Research Council.

There is no recognized official routine for dealing with them. The Department of External Affairs includes no specialized unit to deal with science, nor does it send abroad scientific attachés to serve as permanent representatives. Scientific relations outside the country are certainly maintained after a fashion, but it would be impossible to provide a detailed and orderly statement of how it is done. Canada's ties with the United States are unique, and liaison with its research and development organizations is as close in many cases as that within the country. On the official level the National Research Council has found it useful to keep a staff member permanently in Washington, classed as an attaché in the Canadian Embassy. A comparable situation exists in London and is eventually to be extended to Paris. Similarly, the Defence Research Board maintains official representation in Washington and London.

4 From time to time Canadians are attached for longer or shorter periods to such specialized international bodies as the World Meteorological Organization, the Food and

Agriculture Organization, and the World Health Organization. The official contact with such bodies is through External Affairs, which is advised by the appropriate government department or agency. Relations with UNESCO reveal another type of official international scientific contact. This organization is not exclusively scientific, so the matter of formal representation is more complex. The government has designated the Canada Council as its adviser in this case, and a National Commission has been set up to assist in the work.

5 Canada is also associated with other official international scientific agencies which are not world-wide in membership. Examples are the scientific committees of such bodies as NATO, as well as the British Commonwealth Scientific Committee.

6 At the non-official level the picture is infinitely more complex, due in part to the variety of ways in which the many international scientific bodies are constituted. Most of the larger ones are members of the International Council of Scientific Unions. The National Research Council is Canada's official representative on the Council itself, and in some cases also provides liaison with constituent unions. Although the International Council of Scientific Unions is specifically non-governmental, the National Research Council is able to represent Canada because its membership is made up of non-official scientists.

7 The National Research Council thus meets part of the need. It has responsibilities for advising the government on internal scientific matters, and its President has come to be regarded also as an adviser in external affairs. He is in fact, if not by formal appointment, scientific adviser to the Department of External Affairs, and has on his staff a specialist in international scientific relations. As the National Research Council does not

include in its responsibilities all branches of science, other government agencies quite properly reserve the right to advise External Affairs on matters in their own specific areas of interest—for example, meteorology, geology, geography, agriculture, fisheries, forestry, and oceanography.

8 National Research Council funds provide aid to non-governmental delegates and other scientists to attend international meetings. They do not cover the cost of sending abroad staff members of government departments, and the Council does not necessarily select delegates to represent Canada at international conferences.

9 No mention has been made of scientific visits abroad for other purposes than attending official or other conferences. Yet these are perhaps the most important of all international contacts made by government scientists. There is a steady going and coming of members of departmental and agency staffs. The only central record is kept in the Department of External Affairs, which is responsible for maintaining a list of persons who travel abroad on official passports.

10 To provide continuing comprehensive scientific advice to the Department of External Affairs is far from easy. The National Research Council is understood to regard existing informal arrangements as satisfactory. This view is not generally held in government scientific departments, or in the scientific community at large.

11 *We therefore recommend that:*

Co-ordination of official scientific activities abroad should be a responsibility of the proposed Central Scientific Bureau, with the aid of the Department of External Affairs and the National Research Council.

APPENDICES 1 TO 14

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These statistics cover scientific research and development activities of the departments and agencies of the government. Commercially-oriented Crown corporations such as Polymer Corporation and Trans-Canada Airlines are excluded. The detailed data on the operations and areas of research of individual departments and agencies used by the Commission's staff are not shown. Statistics in the form collected by the Commission are necessary for understanding and for future co-ordination of both the government's research effort and the formulation of policy.

These statistics are based on definitions similar to those used by Dominion Bureau of Statistics. The term "scientific research and development" is defined as investigations carried out in science and technology to derive new knowledge, or to apply new or present knowledge to produce new or modified products or processes. The following activities are included:

- Conduct of research and development including planning and administration.
- Collection of scientific data in support of scientific research and development.
- Scientific information in support of research and development.
- Scholarships and Fellowships.
- Research and development financed in whole or in part by the government through contracts, grants-in-aid or other such arrangements.
- Arrangements with outside organizations for technical services such as testing and evaluation in support of research and development.

Appendix I—TOTAL FEDERAL GOVERNMENT EXPENDITURES BY SECTOR DOING RESEARCH AND DEVELOPMENT

(\$ millions)

	1951- 1952	1952- 1953	1953- 1954	1954- 1955	1955- 1956	1956- 1957	1957- 1958	1958- 1959	1959- 1960	1960- 1961	1961- 1962
<i>Current Expenditures</i>											
Federal government.....	63.71	81.3	89.8	101.0	114.0	113.1	124.0	135.8	142.4	159.6	178.7
Industry ²	3.21	18.9	16.8	23.6	31.7	45.2	53.1	47.6	12.6	13.4	21.3
Educational organizations (universities).....	3.7	4.4	4.5	5.2	5.6	7.0	7.5	10.1	13.5	15.7	17.7
Other (provincial research councils, etc.).....	0.3	0.2	0.3	0.4	0.4	0.6	0.6	0.6	0.8	1.2	1.2
Federal government testing and evaluation of R & D not included elsewhere.....	—	—	—	—	2.0	2.1	1.0	1.5	0.9	1.0	2.9
Sub-Total.....	94.21	104.8	111.4	130.1	153.6	168.0	186.2	195.7	170.3	191.0	221.7
<i>Capital Expenditures</i>											
Federal buildings and works.....	13.3	20.2	15.4	15.3	18.5	26.4	26.4	28.1	31.8	33.8	36.2
TOTAL.....	107.51	125.0	126.8	145.4	172.1	194.4	212.6	223.8	202.1	224.8	257.9

¹Figures for the Royal Canadian Air Force were not available for 1951-52. An estimated \$23.3 million is included in the total but not allocated by sector.

²Atomic Energy of Canada Limited Research Contracts are included in Federal government.

Appendix 2—FEDERAL EXPENDITURES BY KIND OF SCIENTIFIC RESEARCH AND DEVELOPMENT ACTIVITY

(\$ millions)

	1951- 1952	1952- 1953	1953- 1954	1954- 1955	1955- 1956	1956- 1957	1957- 1958	1958- 1959	1959- 1960	1960- 1961	1961- 1962
<i>Operating Expenditures</i>											
Conduct of research and development:											
Total.....	63.9 (7.1)	97.2 (23.4)	103.0 (21.4)	119.7 (28.8)	143.1 (39.1)	155.4 (54.0)	171.7 (61.3)	178.2 (59.2)	153.0 (26.8)	171.9 (29.9)	199.3 (41.0)
Outside Government.....	4.7	5.1	5.8	7.2	6.9	8.3	9.6	12.3	11.2	12.2	14.4
Collection of scientific data.....	1.9	2.1	2.3	2.6	2.7	3.1	3.6	3.9	4.4	4.9	5.6
Scientific information.....	0.3	0.4	0.4	0.6	0.8	1.2	1.4	1.3	1.6	2.0	2.4
Scholarships and fellowships.....											
<i>Capital Expenditures</i>											
Buildings and works.....	13.3	20.2	15.4	15.3	18.5	26.4	26.4	28.1	31.8	33.8	36.2

¹Figures for Royal Canadian Air Force not available for 1951-52.

Appendix 3 — TOTAL SCIENTIFIC RESEARCH AND DEVELOPMENT PROFESSIONAL AND SUPPORTING PERSONNEL¹

	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961
<i>Professional Personnel</i>										
Bachelors.....	1,399	1,357	1,323	1,272	1,321	1,322	1,410	1,698	1,725	1,796
Masters.....	743	798	840	879	918	924	953	1,039	1,018	1,051
Doctorates.....	680	764	845	965	1,075	1,134	1,192	1,435	1,506	1,562
Total Professional ²	3,161	3,661	3,806	3,987	4,239	4,371	4,520	4,717	4,788	4,923
<i>Supporting Personnel</i> ³										
Technical Officers.....	234	234	223	223	241	239	253	240	261	285
Technicians.....	2,221	3,340	3,525	3,688	3,743	3,869	4,248	4,402	4,588	4,698
Craftsmen.....	1,678	2,123	2,119	2,153	2,509	2,573	2,758	2,683	2,696	2,740
Others.....	2,746	3,043	3,149	3,328	3,392	3,542	3,526	3,690	3,718	3,875
Total Supporting ⁴	7,630	9,524	9,872	10,293	10,759	11,197	11,798	12,070	12,348	12,992
Seasonal Personnel.....	2,285	2,263	2,388	2,399	2,445	2,410	2,471	2,380	2,626	2,654

¹Includes personnel engaged in research and development, scientific data collection, scientific information work and administration of scholarship and grants-in-aid of research.

²Total includes estimated number of officers of the Armed Forces who administer or do research and development but may or may not have degrees or the equivalent. Total includes also Atomic Energy of Canada Limited professional personnel not shown by degree.

³In some instances Technical Officers were included with Technicians.

⁴Total includes Atomic Energy of Canada Limited supporting personnel not distributed by category.

Appendix 4—TOTAL EXPENDITURES, OPERATING AND CAPITAL¹, BY FEDERAL GOVERNMENT ON SCIENTIFIC ACTIVITY 1951-52 TO 1961-62

(\$ Thousands)

Department or Agency	1951-1952			1952-1953			1953-1954			1954-1955		
	Operat- ing	Capital	Total	Operat- ing	Capital	Total	Operat- ing	Capital	Total	Operat- ing	Capital	Total
Agriculture.....	11,303	2,919	14,222	12,332	3,049	15,381	13,433	2,710	16,143	15,103	2,628	17,731
Board of Grain Commissioners.....	152	17	169	168	12	180	176	12	188	182	17	199
Forestry.....	3,785	26	3,811	4,461	350	4,811	4,572	418	4,990	4,890	106	4,996
Fisheries.....	1,688	325	2,013	2,044	880	2,924	2,276	521	2,797	2,748	246	2,994
Northern Affairs and National Resources.....	1,345	24	1,369	1,553	50	1,603	1,355	22	1,377	1,675	57	1,732
Mines and Technical Surveys ²	8,802	337	9,139	9,730	389	10,119	10,918	234	11,152	12,926	1,351	14,277
Transport.....	158	—	158	165	—	165	188	—	188	192	—	192
St. Lawrence Seaway Authority.....	—	—	—	—	—	—	—	—	—	—	—	—
Post Office.....	—	—	—	39	—	39	242	—	242	301	—	301
National Film Board.....	17	1	18	27	2	29	31	1	32	26	7	33
Central Mortgage and Housing Corp.....	1	—	1	2	—	2	3	—	3	1	—	1
National Research Council ³	11,881	2,150	14,031	12,643	4,034	16,677	13,845	2,565	16,410	15,239	1,563	16,802
Atomic Energy Control Board.....	200	—	200	200	—	200	200	—	200	200	—	200
Atomic Energy of Canada Limited ⁴	6,625	2,607	9,232	7,425	5,213	12,638	8,739	3,659	12,398	8,734	6,166	14,900
National Health and Welfare.....	1,565	29	1,594	1,985	49	2,034	2,749	579	3,328	2,540	561	3,101
Veterans Affairs.....	287	—	287	294	—	294	298	—	298	334	—	334
Defence Production ⁵	—	—	—	—	—	—	—	—	—	—	75	75
Canadian Arsenal Ltd ⁶	42	—	42	22	—	22	52	—	52	47	—	47
National Defence excluding DRB ^{7,8}	31,900 ¹⁰	—	31,900 ¹⁰	33,249	—	33,249	31,909	—	31,909	29,638	—	29,638
Defence Research Board.....	14,346	4,846	19,192	18,485	6,207	24,692	20,419	4,649	25,068	25,336	2,527	27,863
TOTAL (Civilian and Defence) Overhead ⁹	94,197 ¹⁰	13,281	107,478	104,824	20,235	125,059	111,405	15,370	126,775	130,112	15,304	145,416
	2,400	—	—	3,900	—	—	4,200	—	—	4,700	—	—

(\$ Thousands)

Department or Agency	1955-1956			1956-1957			1957-1958			1958-1959		
	Operat- ing	Capital	Total	Operat- ing	Capital	Total	Operat- ing	Capital	Total	Operat- ing	Capital	Total
Agriculture.....	16,007	3,141	19,148	17,578	4,263	21,841	19,422	6,731	26,153	20,481	5,334	25,815
Board of Grain Commissioners.....	195	30	225	230	17	247	264	30	294	297	67	364
Forestry.....	5,426	160	5,586	5,671	1,124	6,795	6,051	2,621	8,672	6,224	1,352	7,976
Fisheries.....	2,855	825	3,680	3,630	1,225	4,855	4,347	2,203	6,550	4,687	1,652	6,339
Northern Affairs and National Resources.....	2,006	26	2,032	2,205	43	2,248	2,518	38	2,556	2,573	50	2,623
Mines and Technical Surveys ²	12,910	2,644	15,554	15,035	1,400	16,435	16,481	627	17,108	19,777	3,958	23,735
Transport.....	227	—	227	272	100	372	419	25	444	443	13	456
St. Lawrence Seaway Authority.....	—	—	—	9	796	805	98	41	139	49	—	49
Post Office.....	485	—	485	681	—	681	274	—	274	217	—	217
National Film Board.....	23	9	32	25	18	43	28	7	35	29	1	30
Central Mortgage and Housing Corp.....	—	—	—	1	—	1	9	—	9	38	—	38
National Research Council ³	16,152	1,839	17,991	19,072	2,492	21,564	21,442	3,021	24,463	25,062	2,699	27,761
Atomic Energy Control Board.....	300	—	300	300	—	300	400	—	400	400	—	400
Atomic Energy of Canada Limited ⁴	10,694	7,662	18,356	12,910	8,635	21,545	14,074	7,110	21,184	17,404	10,141	27,545
National Health and Welfare.....	2,569	533	3,102	2,784	234	3,018	3,279	80	3,359	3,605	161	3,766
Veterans Affairs.....	330	—	330	357	—	357	388	—	388	319	—	319
Defence Production ⁵	—	230	230	—	3,999	3,999	—	1,892	1,892	—	409	409
Canadian Arsenals Ltd. ⁶	44	—	44	15	—	15	20	—	20	40	—	40
National Defence excluding DRB ^{7,8}	51,344	—	51,344	63,948	—	63,948	71,976	—	71,976	67,352	—	67,352
Defence Research Board.....	31,785	1,405	33,190	23,294	2,071	25,365	24,755	1,966	26,721	26,303	2,222	28,525
TOTAL (Civilian and Defence) Overhead ⁹	153,622	18,504	172,126	168,017	26,417	194,434	186,245	26,392	212,637	195,700	28,059	223,759
	5,000	—	—	5,400	—	—	5,700	—	—	6,300	—	—

Appendix 4 — TOTAL EXPENDITURES, OPERATING AND CAPITAL¹, BY FEDERAL GOVERNMENT ON SCIENTIFIC ACTIVITY 1951-52 TO 1961-62 — Concluded
(\$ Thousands)

Department or Agency	1959-1960			1960-1961			1961-1962		
	Operating	Capital	Total	Operating	Capital	Total	Operating	Capital	Total
Agriculture.....	22,066	6,903	28,969	23,954	4,058	28,012	25,346	5,911	31,257
Board of Grain Commissioners.....	320	41	361	355	84	439	408	49	457
Forestry.....	7,218	433	7,651	8,289	341	8,630	9,563	748	10,311
Fisheries.....	5,172	1,413	6,585	5,626	871	6,497	6,428	2,463	8,891
Northern Affairs and National Resources.....	2,891	84	2,975	3,466	31	3,497	3,498	96	3,594
Mines and Technical Surveys ²	19,844	5,314	25,158	22,174	4,815	26,989	25,644	8,824	34,468
Transport.....	647	163	810	1,096	525	1,621	1,482	1,015	2,497
St. Lawrence Seaway Authority.....	143	—	143	20	—	20	—	—	132
Post Office.....	782	—	782	653	—	653	132	—	36
National Film Board.....	30	9	39	29	1	30	34	2	106
Central Mortgage and Housing Corp.....	50	—	50	51	—	51	106	—	40,885
National Research Council ³	28,694	3,897	32,591	32,167	5,083	37,250	35,614	5,271	700
Atomic Energy Control Board.....	650	—	650	650	—	650	700	—	39,954
Atomic Energy of Canada Limited ⁴	18,611	11,526	30,137	23,098	16,120	39,218	29,756	10,198	5,842
National Health and Welfare.....	4,426	264	4,690	5,339	162	5,501	5,694	148	389
Veterans Affairs.....	343	—	343	357	—	357	389	—	11,464
Defence Production ⁵	1,851	6	1,857	2,902	—	2,902	11,464	—	49
Canadian Arsenal Ltd. ⁶	20	—	20	20	—	20	49	—	32,157
National Defence excluding DRB ^{7,8}	29,341	—	29,341	30,588	—	30,588	32,157	—	34,714
Defence Research Board.....	27,151	1,797	28,948	30,130	1,786	31,916	33,271	1,443	257,903
TOTAL (Civilian and Defence).....	170,250	31,850	202,100	190,964	33,877	224,841	221,735	36,168	—
Overhead ⁹	6,300	—	—	7,000	—	—	7,600	—	—

¹Capital is usually confined to buildings and works separately identified in the *Estimates* and *Public Accounts*.

²Excluded are capital expenditures by the Department of Public Works on behalf of the Mineral Resources Division, the Mines Branch and Geological Survey of Canada.

³Expenditures by Medical Research Council on research grants are included with the National Research Council expenditures.

⁴In addition to the expenditure figures presented, the Commercial Products Division has spent about \$250,000 annually on research and development activities.

⁵Funds provided by Department of Defence Production to develop research capability in industry.

⁶Excluding funds received for development from the Department of National Defence.

⁷Army expenditures have been estimated.

⁸Capital expenditures, by or on behalf of the three services were not available.

⁹Some departments did not take into account the costs of overhead and indirect support from other departments. This was the case with the Department of Mines and Technical Surveys and with each of the three Armed Services. Estimates were derived by determining the percentage which these costs were to intramural expenditures of those departments which did report and applying this to the expenditures of the departments not reporting.

¹⁰Includes an estimated \$23.3 million for the Royal Canadian Air Force.

Appendix 5—SUMMARY OF OPERATING EXPENDITURES ON SCIENTIFIC RESEARCH AND DEVELOPMENT
(\$ Thousands)

	1951-1952			1952-1953			1953-1954			1954-1955		
	Civilian	Defence	Total	Civilian	Defence	Total	Civilian	Defence	Total	Civilian	Defence	Total
Total operating expenditures on scientific activity.....	47,809	46,388 ¹	94,197 ¹	53,068	51,734	104,802	59,025	52,380	111,405	65,092	65,021	130,113
Expenditures on activity performed by—												
Federal government.....	44,745	18,951	63,696	49,829	31,449	81,279	54,900	34,934	89,834	60,526	40,484	101,010
Industry.....	—	3,219	3,219	16	18,849	18,865	113	16,716	16,829	231	23,363	23,594
Educational organizations.....	2,743	931	3,674	2,993	1,436	4,429	3,741	730	4,471	3,983	1,174	5,157
Other organizations.....	321	—	321	230	—	230	271	—	271	352	—	352
Expenditures on research and development.....	40,847	23,101	63,948	45,451	51,734	97,185	50,584	52,380	102,964	54,648	65,021	119,669
Intramural.....	37,886	18,951	56,837	42,347	31,449	73,796	46,677	34,934	81,611	50,409	40,484	90,893
External.....	2,961	4,150	7,111	3,104	20,285	23,389	3,907	17,446	21,353	4,239	24,537	28,776
Expenditures for collection of scientific data.....	4,744	—	4,744	5,091	—	5,091	5,799	—	5,799	7,161	—	7,161
Intramural.....	4,744	—	4,744	5,091	—	5,091	5,799	—	5,799	7,161	—	7,161
External.....	—	—	—	—	—	—	—	—	—	—	—	—
Expenditures for scientific information.....	1,904	—	1,904	2,148	—	2,148	2,263	—	2,263	2,634	—	2,634
Intramural.....	1,904	—	1,904	2,133	—	2,133	2,213	—	2,213	2,571	—	2,571
External.....	—	—	—	15	—	15	52	—	52	63	—	63
Expenditures for scholarships and fellowships.....	314	—	314	378	—	378	379	—	379	649	—	649
Intramural.....	211	—	211	258	—	258	213	—	213	385	—	385
External.....	103	—	103	120	—	120	166	—	166	264	—	264

¹Includes in the total, but not allocated, an estimated \$23.3 million for the RCAF.

Appendix 5—SUMMARY OF OPERATING EXPENDITURES ON SCIENTIFIC RESEARCH AND DEVELOPMENT—Continued

(\$ Thousands)

	1955-1956			1956-1957			1957-1958			1958-1959		
	Civilian	Defence	Total	Civilian	Defence	Total	Civilian	Defence	Total	Civilian	Defence	Total
Total operating expenditures on scientific activity.....	70,449	83,173	153,622	80,760	87,257	168,017	89,494	96,751	186,245	102,005	93,695	195,700
Expenditures on activity performed by—												
Federal government.....	65,042	48,955	113,997	73,856	39,255	113,120	82,599	41,431	124,030	92,543	43,287	135,840
Industry.....	390	31,314	31,704	564	44,643	45,207	151	52,995	53,146	109	47,460	47,569
Educational organizations.....	4,646	924	5,570	5,683	1,297	6,980	6,107	1,367	7,474	8,727	1,417	10,144
Other organizations.....	371	1,980	2,351	648	2,062	2,710	637	958	1,595	626	1,531	2,157
Expenditures on research and development.....	59,957	83,173	143,130	68,114	87,257	155,371	74,909	96,751	171,660	84,541	93,695	178,236
Intramural.....	55,040	48,955	103,995	62,104	39,255	101,359	68,950	41,431	110,381	75,790	43,287	119,077
External.....	4,917	34,218	39,135	6,010	48,002	54,012	5,959	55,320	61,279	8,751	50,408	59,159
Expenditures for collection of scientific data.....	6,935	—	6,935	8,332	—	8,332	9,565	—	9,565	12,281	—	12,281
Intramural.....	6,930	—	6,930	8,317	—	8,317	9,536	—	9,536	12,253	—	12,253
External.....	5	—	5	15	—	15	29	—	29	28	—	28
Expenditures for scientific information.....	2,730	—	2,730	3,065	—	3,065	3,568	—	3,568	3,880	—	3,880
Intramural.....	2,660	—	2,660	2,984	—	2,984	3,488	—	3,488	3,803	—	3,803
External.....	70	—	70	81	—	81	80	—	80	77	—	77
Expenditures for scholarships and fellowships.....	827	—	827	1,249	—	1,249	1,452	—	1,452	1,303	—	1,303
Intramural.....	412	—	412	460	—	460	630	—	630	701	—	701
External.....	415	—	415	789	—	789	822	—	822	602	—	602

Appendix 5—SUMMARY OF OPERATING EXPENDITURES ON SCIENTIFIC RESEARCH AND DEVELOPMENT—Concluded

(\$ Thousands)

	1959-1960			1960-1961			1961-1962		
	Civilian	Defence	Total	Civilian	Defence	Total	Civilian	Defence	Total
Total operating expenditures on scientific activity.....	111,887	58,363	170,250	127,324	63,640	190,964	144,794	76,941	221,735
Expenditures on activity performed by—									
Federal government.....	98,182	44,231	142,413	111,377	48,252	159,629	127,278	51,417	178,695
Industry.....	940	11,667	12,607	766	12,662	13,428	383	20,919	21,302
Educational organizations.....	11,923	1,549	13,472	13,996	1,695	15,691	15,964	1,690	17,654
Other organizations.....	842	916	1,758	1,185	1,031	2,216	1,169	2,915	4,084
Expenditures on research and development.....	94,614	58,363	152,977	108,226	63,640	171,866	122,374	76,941	199,315
Intramural.....	81,911	44,231	126,142	93,734	48,252	141,986	106,880	51,417	158,297
External.....	12,703	14,132	26,835	14,492	15,388	29,880	15,494	25,524	41,018
Expenditures for collection of scientific data.....	11,226	—	11,226	12,192	—	12,192	14,431	—	14,431
Intramural.....	11,196	—	11,196	12,104	—	12,104	14,190	—	14,190
External.....	30	—	30	88	—	88	241	—	241
Expenditures for scientific information.....	4,442	—	4,442	4,932	—	4,932	5,626	—	5,626
Intramural.....	4,356	—	4,356	4,839	—	4,839	5,490	—	5,490
External.....	86	—	86	93	—	93	136	—	136
Expenditures for scholarships and fellowships.....	1,605	—	1,605	1,971	—	1,971	2,363	—	2,363
Intramural.....	719	—	719	697	—	697	728	—	728
External.....	886	—	886	1,274	—	1,274	1,635	—	1,635

Appendix 6 — DISTRIBUTION OF EXPENDITURES ON SCIENTIFIC ACTIVITY BY THE FEDERAL GOVERNMENT FOR SELECTED YEARS 1952-53, 1958-59 AND 1961-62
BY TYPE OF ACTIVITY, AND WHETHER INTRAMURAL OR EXTERNAL

(\$ Thousands)

Department or Agency	1952-1953														
	Total Scientific Activity			Conduct of Research and Development			For Collection of Scientific Data			For Scientific Information			For Scholarships and Fellowships		
	Total	Intra-mural	Outside Organization	Total	Intra-mural	Outside Organization	Total	Intra-mural	Outside Organization	Total	Intra-mural	Outside Organization	Total	Intra-mural	Outside Organization
Agriculture.....	12,332	12,238	94	12,115	12,021	94	—	—	—	217	217	—	—	—	—
Board of Grain Commissioners.....	168	168	—	74	74	—	81	81	—	13	13	—	—	—	—
Forestry.....	4,461	4,459	2	4,461	4,459	2	—	—	—	—	—	—	—	—	—
Fisheries.....	2,044	2,044	—	1,975	1,975	—	—	—	—	69	69	—	—	—	—
Northern Affairs and National Resources.....	1,553	1,552	1	971	970	1	459	459	—	123	123	—	—	—	—
Mines and Technical Surveys.....	9,730	9,710	20	4,129	4,109	20	4,472	4,472	—	1,129	1,129	—	—	—	—
Transport.....	165	165	—	107	107	—	55	55	—	3	3	—	—	—	—
St. Lawrence Seaway Authority	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Post Office.....	39	29	10	39	29	10	—	—	—	—	—	—	—	—	—
National Film Board.....	27	21	6	27	21	6	—	—	—	—	—	—	—	—	—
Central Mortgage and Housing Corp.....	2	—	2	2	—	2	—	—	—	—	—	—	—	—	—
National Research Council.....	12,643	11,195	1,448	11,700	10,387	1,313	—	—	—	565	550	15	378	258	120
Atomic Energy Control Board.....	200	—	200	200	—	200	—	—	—	—	—	—	—	—	—
Atomic Energy of Canada.....	7,425	7,425	—	7,425	7,425	—	—	—	—	—	—	—	—	—	—
National Health and Welfare.....	1,985	530	1,455	1,936	481	1,455	24	24	—	25	25	—	—	—	—
Veterans Affairs.....	294	293	1	290	289	1	—	—	—	4	4	—	—	—	—
Defence Production.....	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Canadian Arsenal's Ltd.....	22	22	—	22	22	—	—	—	—	—	—	—	—	—	—
National Defence.....	51,756	31,471	20,285	51,756	31,471	20,285	—	—	—	—	—	—	—	—	—
Armed Services.....	33,249	14,855	18,394	33,249	14,855	18,394	—	—	—	—	—	—	—	—	—
Defence Research Board.....	18,485	16,594	1,891	18,485	16,594	1,891	—	—	—	—	—	—	—	—	—
Total Defence.....	51,756	31,471	20,285	51,756	31,471	20,285	—	—	—	—	—	—	—	—	—
Total Civilian.....	53,068	49,829	3,239	45,451	42,347	3,104	5,091	5,091	—	2,148	2,133	15	378	258	120
GRAND TOTAL.....	104,824	81,300	23,524	97,207	73,818	23,389	5,091	5,091	—	2,148	2,133	15	378	258	120

Appendix 6 — DISTRIBUTION OF EXPENDITURES ON SCIENTIFIC ACTIVITY BY THE FEDERAL GOVERNMENT FOR SELECTED YEARS 1952-53, 1958-59 AND 1961-62
BY TYPE OF ACTIVITY, AND WHETHER INTRAMURAL OR EXTERNAL — Continued

(\$ Thousands)

Department or Agency	1958-1959											
	Total Scientific Activity			Conduct of Research and Development			For Collection of Scientific Data			For Scientific Information		
	Total	Intra-mural	Outside Organization	Total	Intra-mural	Outside Organization	Total	Intra-mural	Outside Organization	Total	Intra-mural	Outside Organization
Agriculture.....	20,481	20,367	114	20,156	20,042	114	—	—	—	325	325	—
Board of Grain Commissioners.....	297	297	—	117	117	—	152	152	—	28	28	—
Forestry.....	6,624	6,608	16	6,624	6,608	16	—	—	—	—	—	—
Fisheries.....	4,687	4,595	92	4,574	4,486	88	—	—	—	88	88	—
Northern Affairs and National Resources.....	2,573	2,391	182	1,425	1,286	139	964	936	28	184	169	15
Mines and Technical Surveys.....	19,777	19,724	53	6,983	6,930	53	10,722	10,722	—	2,069	2,069	—
Transport.....	443	443	—	300	300	—	139	139	—	4	4	—
St. Lawrence Seaway Authority	49	27	22	49	27	22	—	—	—	—	—	—
Post Office.....	217	200	17	217	200	17	—	—	—	—	—	—
National Film Board.....	29	29	—	29	29	—	—	—	—	—	—	—
Central Mortgage and Housing Corp.....	38	—	38	38	—	38	—	—	—	—	—	—
National Research Council.....	25,062	18,810	6,252	22,660	17,072	5,588	—	—	—	1,132	1,070	62
Atomic Energy Control Board	400	400	—	400	400	—	—	—	—	—	—	—
Atomic Energy of Canada	17,404	17,404	—	17,399	17,399	—	—	—	—	—	—	—
National Health and Welfare.....	3,605	1,345	2,260	3,257	997	2,260	304	304	—	44	44	—
Veterans Affairs.....	319	303	16	313	297	16	—	—	—	6	6	—
Defence Production.....	—	—	—	—	—	—	—	—	—	—	—	—
Canadian Arsenal Ltd.....	40	40	—	40	40	—	—	—	—	—	—	—
National Defence.....	93,655	43,247	50,408	93,655	43,247	50,408	—	—	—	—	—	—
Armed Services.....	67,352	20,583	46,769	67,352	20,583	46,769	—	—	—	—	—	—
Defence Research Board.....	26,303	22,664	3,639	26,303	22,664	3,639	—	—	—	—	—	—
Total Defence.....	93,695	43,287	50,408	93,695	43,287	50,408	—	—	—	—	—	—
Total Civilian.....	102,005	92,543	9,462	84,541	75,790	8,751	12,281	12,253	28	3,880	3,803	77
GRAND TOTAL.....	195,700	135,830	59,870	178,236	119,077	59,159	12,281	12,253	28	3,880	3,803	77
										1,303	701	602
										1,303	701	602

Appendix 6 — DISTRIBUTION OF EXPENDITURES ON SCIENTIFIC ACTIVITY BY THE FEDERAL GOVERNMENT FOR SELECTED YEARS 1952-53, 1958-59 AND 1961-62
BY TYPE OF ACTIVITY, AND WHETHER INTRAMURAL OR EXTERNAL — Concluded

(\$ Thousands)

Department or Agency	1961-1962											
	Total Scientific Activity			Conduct of Research and Development			For Collection of Scientific Data			For Scientific Information		
	Total	Intra-mural	Outside Organization	Total	Intra-mural	Outside Organization	Total	Intra-mural	Outside Organization	Total	Intra-mural	Outside Organization
Agriculture.....	25,346	25,206	140	24,934	24,794	140	—	—	—	412	412	—
Broad of Grain Commissioners	408	408	—	171	171	—	201	201	—	36	36	—
Forestry.....	9,563	9,552	11	9,563	9,552	11	—	—	—	—	—	—
Fisheries.....	6,428	6,231	197	6,312	6,125	187	—	—	—	88	88	—
Northern Affairs and National Resources.....	3,498	3,131	367	1,725	1,435	290	1,495	1,454	41	278	242	36
Mines and Technical Surveys.....	25,644	25,569	75	10,859	10,784	75	11,629	11,629	—	3,156	3,156	—
Transport.....	1,482	1,410	72	928	856	72	434	434	—	120	120	—
St. Lawrence Seaway Authority	—	—	—	—	—	—	—	—	—	—	—	—
Post Office.....	132	56	76	132	56	76	—	—	—	—	—	—
National Film Board.....	34	34	—	34	34	—	—	—	—	—	—	—
Central Mortgage and Housing Corp.....	106	—	106	106	—	106	—	—	—	—	—	—
National Research Council	35,614	23,557	12,057	31,656	21,534	10,122	200	—	200	1,473	1,373	100
Atomic Energy Control Board	700	—	700	700	—	700	—	—	—	—	—	—
Atomic Energy of Canada.....	29,756	29,756	—	29,706	29,706	—	—	—	—	—	—	—
National Health and Welfare.....	5,694	1,994	3,700	5,170	1,470	3,700	472	472	—	52	52	—
Veterans Affairs.....	389	374	15	378	363	15	—	—	—	11	11	—
Defence Production.....	11,464	—	11,464	11,464	—	11,464	—	—	—	—	—	—
Canadian Arsenal Ltd.....	49	49	—	49	49	—	—	—	—	—	—	—
National Defence.....	65,428	51,368	14,060	65,428	51,368	14,060	—	—	—	—	—	—
Armed Services.....	32,157	21,766	10,391	32,157	21,766	10,391	—	—	—	—	—	—
Defence Research Board.....	33,271	29,602	3,669	33,271	29,602	3,669	—	—	—	—	—	—
Total Defence.....	76,941	51,417	25,524	76,941	51,417	25,524	—	—	—	—	—	—
Total Civilian.....	144,794	127,278	17,516	122,374	106,880	15,494	14,431	14,190	241	5,626	5,490	136
GRAND TOTAL.....	221,735	178,695	43,040	199,315	158,297	41,018	14,431	14,190	241	5,626	5,490	136

Appendix 7—AVERAGE EXPENDITURE ON SCIENTIFIC ACTIVITY WITHIN THE FEDERAL GOVERNMENT PER PROFESSIONAL EMPLOYEE—1951-52 TO 1960-61

(\$ Thousands)

Department or Agency	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961
Agriculture.....	13.7	14.2	15.3	16.7	17.4	19.1	20.9	21.9	23.5	25.8
Board of Grain Commissioners.....	15.2	16.8	16.0	18.2	19.5	19.1	22.0	22.8	24.6	27.3
Forestry.....	15.6	18.3	18.3	18.9	20.5	20.9	21.8	22.7	25.6	26.8
Fisheries.....	11.4	14.2	14.8	18.3	18.4	21.9	23.8	23.6	26.2	25.2
Northern Affairs and National Resources.....	11.2	12.8	12.8	14.7	15.8	16.1	17.0	17.4	17.9	20.2
Mines and Technical Surveys.....	18.9	19.6	21.7	25.4	24.4	28.9	30.8	35.0	31.8	33.5
Transport.....	6.0	5.3	5.6	5.8	6.3	6.8	9.7	10.0	11.1	15.3
St. Lawrence Seaway Authority	—	—	—	—	—	—	—	—	—	—
Post Office.....	—	—	—	—	—	—	—	—	—	—
National Film Board.....	17.0	22.0	25.0	11.0	7.6	8.3	9.3	9.6	15.0	29.0
Central Mortgage and Housing Corp.....	—	—	—	—	—	—	—	—	—	—
National Research Council.....	21.3	22.2	21.7	22.6	22.9	25.2	28.1	28.2	29.0	30.8
Atomic Energy Control Board.....	—	—	—	—	—	—	—	—	—	—
Atomic Energy of Canada.....	32.1	29.1	31.2	26.3	30.5	33.7	32.2	36.0	35.9	43.1
National Health and Welfare.....	7.1	11.2	15.9	13.4	12.4	11.9	15.5	13.5	18.5	14.1
Veterans Affairs.....	—	—	—	—	—	—	—	—	—	—
Defence Production.....	—	—	—	—	—	—	—	—	—	—
National Defence.....	32.1	33.0	34.9	38.0	40.8	31.1	32.3	33.1	34.8	38.9
Armed Services.....	29.5	26.8	27.1	28.2	29.0	27.8	29.0	29.1	28.6	32.7
Defence Research Board.....	33.4	41.6	46.0	51.1	54.5	34.8	36.1	37.8	42.4	46.0
Total Defence.....	29.2	30.8	32.7	35.6	38.3	24.3	30.4	31.3	33.1	37.0
Total Civilian.....	17.8	18.8	20.0	21.2	21.9	29.0	26.0	27.6	28.3	30.7
GRAND TOTAL.....	20.1	22.2	23.6	25.3	26.8	25.8	27.4	28.7	29.7	32.4

Appendix 8 — FEDERAL EXPENDITURES ON INTRAMURAL RESEARCH AND DEVELOPMENT

(\$ Thousands)

Department or Agency	1951- 1952	1952- 1953	1953- 1954	1954- 1955	1955- 1956	1956- 1957	1957- 1958	1958- 1959	1959- 1960	1960- 1961	1961- 1962
Agriculture.....	11,271	12,238	13,336	14,995	15,890	17,457	19,316	20,367	21,912	23,818	25,206
Board of Grain Commissioners.....	152	168	176	182	195	230	264	297	320	335	408
Forestry.....	3,782	4,459	4,566	4,881	5,417	5,665	6,045	6,608	7,194	8,266	9,552
Fisheries.....	1,688	2,044	2,276	2,748	2,830	3,596	4,309	4,595	5,071	5,504	6,231
Northern Affairs and National Resources.....	1,345	1,552	1,353	1,598	1,916	2,040	2,316	2,391	2,582	3,052	3,131
Mines and Technical Surveys.....	8,792	9,710	10,893	12,901	12,885	14,995	16,441	19,724	19,791	22,121	25,569
Transport.....	158	165	188	192	227	272	419	443	647	1,044	1,410
St. Lawrence Seaway Authority.....	—	—	—	—	—	9	30	27	23	20	—
Post Office Department.....	—	29	135	74	95	117	191	200	39	50	56
National Film Board.....	17	22	25	22	23	25	28	29	30	29	34
National Research Council.....	10,177	11,195	12,008	13,084	13,488	15,332	17,613	18,810	20,112	21,927	23,557
Atomic Energy Control Board.....	—	—	—	—	—	—	—	—	—	—	—
Atomic Energy of Canada Ltd. ¹	6,625	7,425	8,739	8,734	10,964	12,910	14,074	17,404	18,611	23,098	29,756
National Health and Welfare.....	452	530	909	782	784	861	1,181	1,345	1,518	1,739	1,994
Veterans Affairs ²	286	293	296	333	328	356	372	303	332	354	374
Canadian Arsenals Limited.....	42	—	52	47	44	15	20	40	20	20	49
National Defence Armed Services.....	(5,948) ³	(14,855)	(15,920)	(17,229)	(18,617)	(18,737)	(19,924)	(20,583)	(19,864)	(21,362)	(21,766)
Defence Research Board.....	(12,961)	(16,594)	(18,962)	(23,208)	(30,294)	(20,503)	(21,487)	(22,664)	(24,347)	(26,870)	(29,602)
Total Defence.....	18,951 ³	31,449	34,934	40,484	48,955	39,255	41,431	43,287	44,231	48,252	51,417
Total Civilian.....	44,745	49,830	54,900	60,526	65,042	73,856	82,599	92,543	98,182	111,377	127,278
GRAND TOTAL.....	63,696 ³	81,279	89,834	101,010	113,997	113,111	124,030	135,830	142,413	159,629	178,695

¹Includes some research and development contracts with industry.

²Veterans Affairs funds may go, in part, to scientists associated with the universities.

³Excluded are expenditures for development made by the RCAF.

Appendix 9—FEDERAL EXPENDITURES ON RESEARCH AND DEVELOPMENT BY INDUSTRY

(\$ Thousands)

Department or Agency	1951- 1952	1952- 1953	1953- 1954	1954- 1955	1955- 1956	1956- 1957	1957- 1958	1958- 1959	1959- 1960	1960- 1961	1961- 1962
Fisheries.....	—	—	—	—	—	—	—	70	77	56	60
Department of Transport.....	—	—	—	—	—	—	—	—	—	52	47
St. Lawrence Seaway Authority.....	—	—	—	—	—	—	68	22	120	—	—
Post Office Department.....	—	10	107	227	390	564	83	17	743	603	76
National Film Board.....	—	6	6	4	—	—	—	—	—	—	—
National Research Council.....	—	—	—	—	—	—	—	—	—	—	200
Atomic Energy of Canada Ltd. ¹	—	—	—	—	—	—	—	—	—	—	—
Defence Production.....	—	—	—	—	—	—	—	—	1,851	2,902	11,464
National Defence.....	—	—	—	—	—	—	—	—	—	—	—
Excluding Defence Research Board.....	(2,765) ²	(18,394)	(15,989)	(22,409)	(30,747)	(43,149)	(51,094)	(45,238)	(8,561)	(8,195)	(7,476)
Defence Research Board.....	(454)	(455)	(727)	(954)	(567)	(1,494)	(1,901)	(2,222)	(1,255)	(1,565)	(1,979)
TOTAL.....	3,2192	18,865	16,829	23,594	31,704	45,207	53,146	47,569	12,607	13,428	21,302

¹Excludes contracts, mostly with industry, which amounted, in year for which information was obtained, to \$3,129,722 in 1959-60; \$4,767,572 in 1960-61; and provision for \$7.8 million in 1961-62 of which \$4.7 million was spent.

²Excludes development contracts in 1951-52 by the Royal Canadian Air Force.

Appendix 10 — FEDERAL EXPENDITURES ON RESEARCH AND DEVELOPMENT BY UNIVERSITIES
(\$ Thousands)

Department or Agency	1951- 1952	1952- 1953	1953- 1954	1954- 1955	1955- 1956	1956- 1957	1957- 1958	1958- 1959	1959- 1960	1960- 1961	1961- 1962
Agriculture ¹	—	—	—	—	—	—	—	—	—	—	—
Forestry.....	3	2	6	9	9	6	6	16	24	23	11
Fisheries.....	—	—	—	—	25	34	38	22	8	7	33
Northern Affairs and National Resources.....	—	—	—	—	9	25	13	20	15	15	—
Mines and Technical Surveys.....	10	20	25	25	25	40	40	53	53	53	75
Department of Transport.....	—	—	—	—	—	—	—	—	—	—	25
Central Mortgage and Housing Corp.....	—	—	—	—	—	—	—	—	—	—	—
National Research Council.....	1,417	1,316	1,670	1,990	2,493	3,355	3,512	5,956	8,265	9,648	11,420
Atomic Energy Control Board.....	200	200	200	200	300	300	400	400	650	650	700
Atomic Energy of Canada Ltd. ²	—	—	—	—	—	—	—	—	—	—	—
National Health and Welfare ³	1,113	1,455	1,840	1,759	1,785	1,923	2,098	2,260	2,908	3,600	3,700
Veterans Affairs ⁴	—	—	—	—	—	—	—	—	—	—	—
Defence Research Board.....	931	1,436	730	1,174	924	1,297	1,367	1,417	1,549	1,695	1,690
GRAND TOTAL.....	3,674	4,429	4,471	5,157	5,570	6,980	7,474	10,144	13,472	15,691	17,654

¹Extramural research grants classified as grants to "other organizations".

²Atomic Energy of Canada Limited makes some minor contracts with the universities for research.

³Some of these funds go to organizations not closely associated with the universities.

⁴Veterans Affairs funds for research may go to scientists associated with the universities.

Appendix 11 — FEDERAL EXPENDITURES ON RESEARCH AND DEVELOPMENT BY OTHER ORGANIZATIONS

(\$ Thousands)

Department or Agency	1951- 1952	1952- 1953	1953- 1954	1954- 1955	1955- 1956	1956- 1957	1957- 1958	1958- 1959	1959- 1960	1960- 1961	1961- 1962
Agriculture ¹	32	94	97	108	117	121	106	114	154	136	140
Forestry.....	—	—	—	—	—	—	—	—	—	—	—
Fisheries.....	—	—	—	—	—	—	—	—	16	59	104
Northern Affairs and National Resources.....	—	1	2	77	81	140	189	162	294	399	367
Central Mortgage and Housing Corp.....	1	2	3	1	—	1	9	38	50	51	106
National Research Council.....	287	132	167	165	171	385	317	296	317	537	437
Veterans Affairs.....	1	1	2	1	2	1	16	16	11	3	15
National Defence											
Total — Three Services ²	—	—	—	—	(1,980)	(2,062)	(958)	(1,531)	(916)	(1,031)	(2,915)
Departmental Total.....	—	—	—	—	1,980	2,062	958	1,531	916	1,031	2,915
GRAND TOTAL (Civilian and Defence).....	321	230	271	352	371	648	637	626	842	1,185	1,169

¹Extramural research grants, mainly to universities.

²Navy Testing and Evaluation of Research and Development for other Agencies (not included in grand total).

Appendix 12—PROFESSIONAL AND SUPPORTING PERSONNEL ENGAGED IN SCIENTIFIC ACTIVITY WITHIN THE FEDERAL GOVERNMENT, 1952-53, 1958-59 AND 1960-61

Department or Agency	1952-1953								
	Bachelors	Masters	Doc- torates	Total Profes- sionals	Tech- nicians ⁵	Craftsmen	Others	Total Supporting	Seasonal
Agriculture.....	330	331	196	857	384	249	882	1,515	443
Board of Grain Commissioners.....	3	2	5	10	17	3	6	26	—
Forestry.....	105	81	57	243	205	—	163	368	393
Fisheries.....	49	55	39	143	110	10	93	213	82
Northern Affairs and National Resources.....	91	18	12	121	36	77	123	236	25
Mines and Technical Surveys.....	319	69	107	495	602	135	312	1,049	1,136
Transport.....	7	21	3	31	2	1	3	6	—
St. Lawrence Seaway Authority.....	—	—	—	—	—	—	—	—	—
Post Office.....	—	—	—	—	—	—	—	—	—
National Film Board.....	1	—	—	1	3	—	—	3	2
Central Mortgage and Housing Corp.....	—	—	—	—	—	—	—	—	—
National Research Council.....	154	96	188	438	—	—	—	7782	2007
Atomic Energy Control Board.....	—	—	—	—	—	—	—	—	—
Atomic Energy of Canada ¹	—	—	—	255	287	890	279	1,456	17
National Health and Welfare.....	15	10	22	47	21	—	14	35	—
Veterans Affairs.....	—	—	—	—	—	—	—	—	—
Defence Production ¹	—	—	—	1	—	—	—	—	—
Canadian Arsenalns Ltd.....	58	7	2	67	81	1	1	83	—
National Defence ^{3,4}	—	—	—	952	1,644	599	1,166	3,7652	65
Total, Three Services ^{1,3,4,6}	—	—	—	554	1,065	300	24	1,7452	—
Defence Research Board.....	157	108	133	398	579	299	1,142	2,020	65
GRAND TOTAL (Civilian and Defence) ^{1,3,4}	1,289	798	764	3,511	3,392	1,965	3,042	9,5332	2,263

Appendix 12—PROFESSIONAL AND SUPPORTING PERSONNEL ENGAGED IN SCIENTIFIC ACTIVITY WITHIN THE FEDERAL GOVERNMENT, 1952-53, 1958-59
AND 1960-61—Continued

Department or Agency	1958-1959						
	Bachelors	Masters	Doc- torates	Total Profes- sionals	Tech- nicians ⁵	Craftsmen	Others
Agriculture.....	231	336	361	928	448	441	997
Board of Grain Commissioners.....	4	—	9	13	29	3	8
Forestry.....	97	109	84	290	275	—	175
Fisheries.....	62	58	74	194	206	15	171
Northern Affairs and National Resources.....	82	36	19	137	60	30	114
Mines and Technical Surveys.....	318	71	169	558	782	191	364
Transport.....	13	27	4	44	18	1	7
St. Lawrence Seaway Authority.....	—	—	—	—	—	—	—
Post Office.....	—	—	—	—	—	—	—
National Film Board.....	2	1	—	3	2	—	—
Central Mortgage and Housing Corp.....	—	—	—	—	—	—	—
National Research Council.....	132	119	336	587	—	—	—
Atomic Energy Control Board.....	—	—	—	—	—	—	—
Atomic Energy of Canada ¹	271	64	148	483	380	1,212	556
National Health and Welfare.....	24	31	44	99	52	—	64
Veterans Affairs.....	—	—	—	—	—	—	—
Defence Production ¹	—	—	—	4	—	—	—
Canadian Arsenal Ltd.....	60	9	2	71	95	3	2
National Defence ^{3,4}	—	—	—	1,306	2,295	787	1,232
Total, Three Services ^{1,3,4,6}	—	—	—	707	1,520	441	29
Defence Research Board.....	238	176	185	599	775	346	1,203
GRAND TOTAL (Civilian and Defence) ^{1,3,4}	1,534	1,037	1,435	4,717	4,642	2,683	3,690
							2,580

Appendix 12 — PROFESSIONAL AND SUPPORTING PERSONNEL ENGAGED IN SCIENTIFIC ACTIVITY WITHIN THE FEDERAL GOVERNMENT, 1952-53, 1958-59
AND 1960-61 — Concluded

Department or Agency	1960-1961								
	Bachelors	Masters	Doc- torates	Total Profes- sionals	Tech- nicians ⁵	Craftsmen	Others	Total Supporting	Seasonal
Agriculture.....	195	301	425	921	579	501	986	2,066	476
Board of Grain Commissioners.....	4	1	8	13	29	3	9	41	—
Forestry.....	93	119	96	308	297	—	209	506	368
Fisheries.....	76	53	89	218	216	14	191	421	170
Northern Affairs and National Resources.....	93	32	26	151	76	17	133	2282	31
Mines and Technical Surveys.....	362	87	204	653	863	185	410	1,458	1,295
Transport.....	27	36	5	68	34	1	16	51	7
St. Lawrence Seaway Authority.....	—	—	—	—	—	—	—	—	—
Post Office.....	—	—	—	—	—	—	—	—	—
National Film Board.....	1	—	—	1	1	—	—	1	—
Central Mortgage and Housing Corp.....	—	—	—	—	—	—	—	—	—
National Research Council.....	162	125	337	624	—	—	—	1,1222	2007
Atomic Energy Control Board.....	—	—	—	—	—	—	—	—	—
Atomic Energy of Canada ¹	323	72	140	535	480	1,214	619	2,313	46
National Health and Welfare.....	32	38	53	123	77	—	77	154	—
Veterans Affairs.....	—	—	—	—	—	—	—	—	—
Defence Production ¹	—	—	—	6	—	—	5	5	—
Canadian Arsenalns Ltd.....	56	8	1	65	88	3	2	93	—
National Defence ^{3,4}	—	—	—	1,237	2,243	802	1,223	4,268	61
Total, Three Services ^{1,3,4,6}	—	—	—	653	1,443	451	29	1,923	—
Defence Research Board.....	231	175	178	584	800	351	1,194	2,345	61
GRAND TOTAL (Civilian and Defence) ^{1,3,4}	1,655	1,047	1,562	4,923	4,983	2,740	3,875	12,7222	2,654

¹Professional personnel classified by degree not available. Column totals include only data shown.

²Supporting personnel classified by categories given — not available for the Army or N.R.C.

³Armed Services personnel not classified by degrees.

⁴Army professional and supporting personnel estimated for 1951-52 to 1957-58.

⁵Includes technical officers. ⁶Persons with rank of officer classified as professional personnel. ⁷Estimated.

Appendix 13 — RATIO OF TECHNICIANS TO PROFESSIONAL PERSONNEL ENGAGED IN SCIENTIFIC ACTIVITY WITHIN THE FEDERAL GOVERNMENT FOR SELECTED DEPARTMENTS OR AGENCIES — 1951-52 TO 1960-61¹

Department or Agency	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961
Agriculture.....	0.3	0.3	0.4	0.3	0.4	0.4	0.4	0.5	0.5	0.6
Mines and Technical Surveys.....	1.1	1.0	1.1	1.1	1.0	1.1	1.1	1.1	1.1	1.1
National Research Council.....	—	—	—	—	—	—	—	—	—	—
Atomic Energy of Canada.....	1.1	1.1	1.0	0.9	1.0	1.0	0.9	0.7	0.8	0.9
Defence Research Board.....	1.2	1.4	1.5	1.6	1.2	1.2	1.2	1.2	1.3	1.4

¹Technical officers included with technicians.

Appendix 14 — RATIO OF SUPPORTING PERSONNEL (INCLUDING TECHNICIANS) TO PROFESSIONAL PERSONNEL ENGAGED IN SCIENTIFIC ACTIVITY WITHIN THE FEDERAL GOVERNMENT FOR SELECTED DEPARTMENTS OR AGENCIES, 1951-52 TO 1960-61¹

Department or Agency	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961
Agriculture.....	1.8	1.7	1.7	1.8	1.8	1.9	2.0	2.0	2.1	2.2
Mines and Technical Surveys.....	2.1	2.1	2.2	2.2	2.2	2.3	2.4	2.3	2.2	2.2
National Research Council.....	1.7	1.7	1.7	1.7	1.7	1.8	1.8	1.7	1.7	1.8
Atomic Energy of Canada.....	5.8	5.7	5.3	4.8	5.1	5	4.8	4.4	4.2	4.3
Defence Research Board.....	4.4	5	5.1	4.8	4.1	3.8	3.8	3.8	4.0	4.0

¹Technical officers included with technicians.

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